LWIFI, LWIFIX, LNET1

Gen 2 Laureate Communication Boards

User Manual

CE

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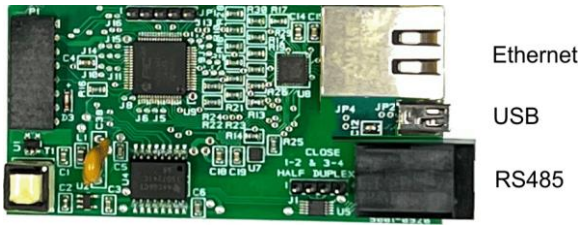
2. GEN 2 COMMUNICATION BOARDS OVERVIEW

Laurel Gen 2 (second generation) communication boards were introduced in 2022. LWIFI and LWIFIX are new WiFi products. The new LNET1 Ethernet board can replace the legacy Gen 1 (first generation) LNET and LNET485 communication boards. All three Gen 2 boards offer USB and RS485 communications in addition to WiFi or Ethernet communications. They are low in cost and use cache memory for high read rates. They fit into the middle option slot of Laureate 1/8 DIN sized meters and counters.

Three boards covered by this user manual:

- **LNET1** connects its host meter to an Ethernet local area network (LAN) via an RJ45 connector and a standard 10/100 Base-T Ethernet cable. It also comes with a mini-USB jack and an RJ11 jack for RS485. USB is used for discovery using Laurel Network Setup (LNS) software and can also be used for data transfer to a PC at 38400 baud. RS485 can be used for data transfer to a PC at up to 115200 baud and for data transfer at 19200 baud to an RS485 bus with up to 31 Laureate meters and LT series transmitters. The board's host (or Main) meter and all Laureate instruments on the RS485 bus can be programmed over the USB port using our Instrument Setup (IS) software.



- **LWIFI** is a circuit board with an integral (or printed) WiFi antenna to minimize use of 4-20 mA or serial communication cables. It is intended for WiFi applications where the meter can be mounted on a benchtop or inside a plastic enclosure that does not block radio waves. It is ideal for communication distances of 30 m (100 ft) or less. LWIFI also comes with a mini-USB jack and an RJ11 jack for RS485. USB is used for discovery using Laurel Network Setup (LNS) software and can also be used for data transfer to a PC at 38400 baud. RS485 can be used for data transfer to a PC at up to 115200 baud and for data transfer at 19200 baud to an RS485 bus with up to 31 Laureate meters and LT series transmitters. The board's host (or Main) meter and all Laureate instruments on the RS485 bus can be programmed over the USB port using our Instrument Setup (IS) software.

- **LWIFIX** is an assembly which consists of a WiFi board, an external antenna, and a 760 mm (30”) long antenna cable. This assembly is designed for WiFi applications where the meter is mounted inside a metal cabinet that would block radio waves. By using an outside antenna over a ground plane, LWIFIX provides more range than LWIFI. It also provides the same USB and RS485 ports as LWIFI for programming, data transfer or gateway operation to an RS485 bus with up to 31 Laureate meters and LT transmitters.

High data rates are a major advantage of Gen 2 communication boards compared to legacy Gen 1 boards when used for data polling. The legacy communications boards, which include RS232, RS485, USB and Ethernet, are limited to about 2 updates per second when used in a polling command mode since they only operate at up to 9600 baud, and the meter’s 8-bit processor has to perform meter operation and communication operations in sequence. In Gen 2 communication boards, a more powerful onboard processor polls the meter’s microcomputer board at 19200 baud at rates up to 60 readings per sec and stores data in cache memory. The cached data can then be read asynchronously by an external master as fast as every 2 msec with Ethernet or every 10 msec with WiFi or USB. Please see the Data Update Rates section of this manual.

The Modbus protocol is used for all external communications with Gen 2 boards. That protocol is a master-slave protocol, where a master (typically a PC or PLC) issues commands, and a slave (or instrument) responds to these commands, for example by supplying data. The protocol is named Modbus TCP/IP when used with WiFi or Ethernet, and Modbus RTU when used with USB or RS485. The command set is the same, as documented in the Modbus Implementation section of this manual.

Laurel’s Custom ASCII protocol is not available for external commands with Gen 2 products and there is no data streaming. However, Modbus commands are seamlessly translated by the Gen 2 board processor to Custom ASCII commands for internal operation, which includes communications between the Gen 2 board and the host meter, and between the Gen 2 board and remote instruments on an RS485 bus. This explains which the host meter and remote meters have to set up for the Custom ASCII protocol.

3. GEN 2 BOARD INSTALLATION

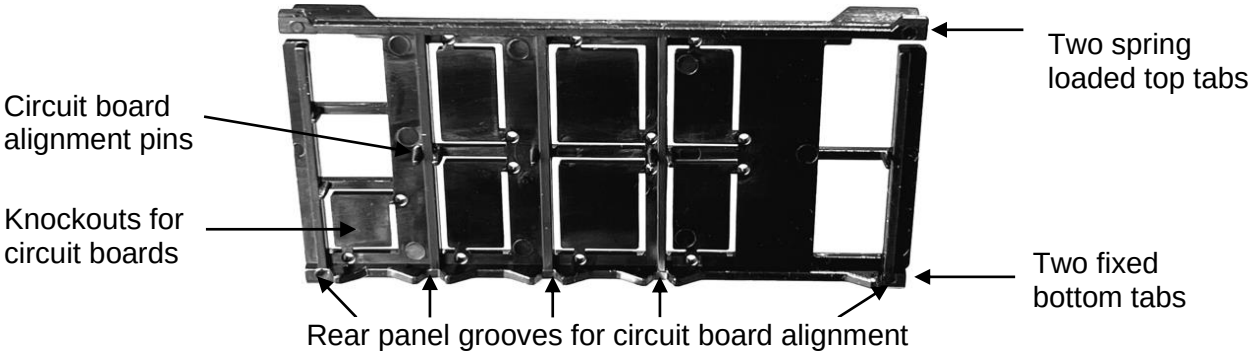
Laurel Gen 1 or Gen 2 communication boards come installed in a Laureate meter or counter when called out in the sixth position of the meter or counter model number. For example, an L2000**C**DCV1 meter includes a WiFi board P/N LWIFI with an internal antenna. Please see the photo to the right of a meter with a WiFi board in the middle slot. Visible are the Mini-USB and RS485 connectors.

6th Digit	Board Description	Gen 1 P/N	Gen 2 P/N
0	None (no communications board)		
1	RS232 with one RJ11 jack	L232	
2	RS485 with two RJ11 jacks for daisy chaining (recommended for RS485 bus)	L485	
4	RS485 with two RJ45 Jacks (use RJ11 jacks for new designs)	LMOD	
5	USB with one USB Type B jack	LUSB	
6	USB-to-RS485 gateway with USB Type B jack and RJ11 jack for RS485	LUSB485	
7	Ethernet with one RJ45 jack (not for new designs)	LNET	
8	Ethernet-to-RS485 gateway with RJ45 and RJ11 jacks (not for new designs)	LNET485	
A	Ethernet plus mini-USB Type B jack plus RJ11 jack for RS485		LNET1
C	WiFi with internal antenna plus mini-USB Type B jack plus RJ11 jack for RS485		LWIFI
D	WiFi with external antenna plus mini-USB Type B jack plus RJ11 jack for RS485		LWIFIX

Communication boards can also be installed later by the user by inserting them into the middle backplane slot that is reserved for communications boards. The boards are automatically recognized by the meter's processor, but software setup is required as detailed in this manual.

Disassembling your meter

To install a new board, first remove the electronics assembly from its case. The first step of disassembly is to remove any connectors. Then use a flat blade screwdriver to press down on two spring-loaded tabs at the top of the rear panel to free the panel from slits at the top the case. Lift up the rear panel to free it from the slits at the bottom. This will unhook the rear panel, and the electronics assembly will slide out.

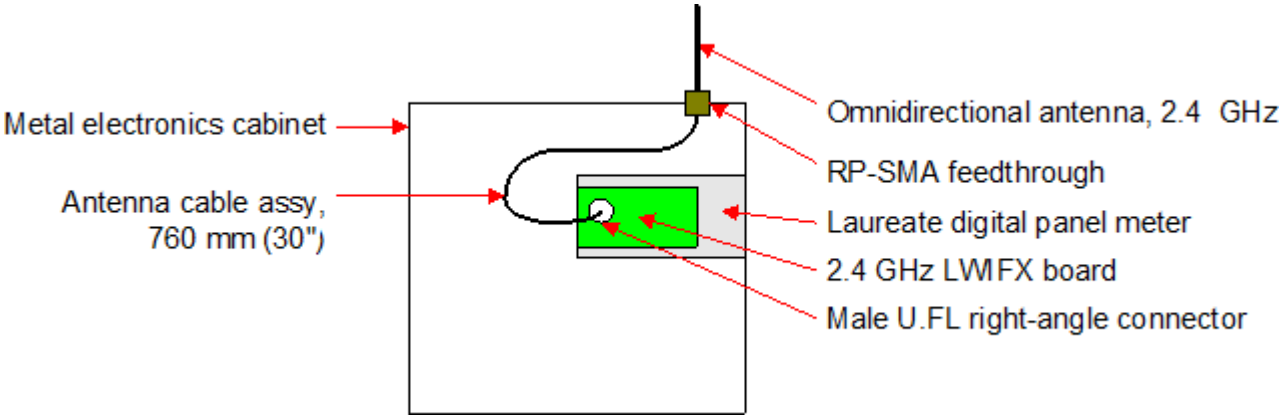


Reassembling your meter

1. Verify that the top and bottom edges of all circuit boards are at the same horizontal level. If boards are inserted one electrical pin off, this may burn out the electronics.
2. Slide the electronics assembly back into the case until the display board is seated flush against the front of the case.
3. If the added board is an LNET1, using wire cutters to snip off the horizontal plastic divider.
4. Carefully insert the fixed bottom tabs of the rear panel into the bottom of the case, then nudge the circuit boards from side to side with a flat-blade screwdriver until each board is held firmly by an alignment groove in the rear panel. Also note the alignment pins in the middle of the rear panel.
5. Once all boards are held firmly, insert the top tabs of the rear panel into the case.
6. Verify that the installed rear panel is flat. If it is bulging out, if the top tabs cannot be inserted, or if there is no room for connectors, realign the rear panel.
7. Once the rear panel is in place, reinstall the connectors.

4. WIFI BOARD INSTALLATION & RANGE CONSIDERATIONS

A digital panel meter with an LWIFI board, which comes with an internal printed antenna, needs to be mounted on a benchtop or in a plastic enclosure that is transparent to 2.4 GHz radio waves. WiFi is suitable for indoor communication distances of 30 m (100 ft) or less. The presence of nearby circuit board traces reduces power radiated by LWIFI by about 10 dB compared to LWIFIX with an external antenna.



A meter with an LWIFIX board, which comes with an external antenna and a 760 mm (30”) long antenna cable, can be mounted inside a metal cabinet that blocks radio waves. The antenna should be vertical and be mounted on the top surface of the cabinet, which will then act as the antenna’s ground plane and help shape an antenna pattern which is omnidirectional in the horizontal plane. The antenna gain in the horizontal direction is 5 dBi. Also consider using LWFIX in lieu of LWIFI, since it has about 10 dB higher output.

WiFi range depends on many factors. These include the radiated power and sensitivities not only of the WiFi board but also of the WiFi router. Received radio power on either end is increased by the sum of gains in dB of both antennas. It is decreased by loss in dB of the antenna cable inside the cabinet and most significantly by loss in dB along the radio path. Each -3 dB reduces power by a factor of 2. Each -10 dB reduces power by a factor of 10.

WiFi range can be 90 m (300 ft) with an unobstructed line-of-sight connection outdoors, but it is half of that or less indoors. Signal loss is caused by materials like concrete, bricks or plaster that absorb radio waves, and by nearby metal objects that reflect and scatter radio waves. To maximize range, minimize obstructions between the WiFi router and meter antennas. Also maximize the height of both antennas. If possible, place the WiFi router in a raised, central location to eliminate WiFi dead zones. WiFi range is also reduced by interference from competing 2.4 GHz signals from other WiFi networks, IoT devices and leaked radiation from products like microwave ovens.

5. NETWORK SETUP UTILITY INSTALLATION

Laurel Network Setup (LNS) is a software utility that must be run on a PC to set up Gen 2 communication boards prior to their use. It works with the microcontroller used in Gen 2 boards, not in older Gen 1 boards.

Download the file NetworkSetup_2_1.exe (100 kB) from Laurel's software downloads web page or click here. Copy the downloaded file into a PC directory of your choice. You may also wish to past a shortcut on your Windows desktop. To execute, double-click on the file name or on your shortcut.

Before you can run LNS software on a PC, the Gen 2 LNET1, LWIFI or LWFIX communications board must be set up by connecting to the USB port of the PC via a communication cable. Since all three boards have a mini-USB Type B jack, the easiest connection is via a readily available USB cable with a mini-USB Type B connector and a USB Type A connector like our CBL07 cable. It is also possible to make the connection via the board's RS485 jack by using our CBL06 RS485-to-USB adapter cable.

Before you can run LNS software on a PC, the host meter of the Gen 2 communications board must be set up to the following:

- 19200 baud
- Custom ASCII protocol
- No parity, 8 data bits, 1 stop bit (N81), address 1.

To do so, enter these settings from the meter front panel, as illustrated on the next page:

- SEr 1: 160
- SEr 2: 0111
- SEr 3: 00000
- SEr 4: 000

If the connecting cable is missing or if the communication settings of the host meter are not correct, you will get the error message "No Network Board Found."

KEYSTROKES FOR SERIAL COMMUNICATIONS SETUP

If the *MENU* ↵ key does not work, see Section 9 "Enabling & Locking Out Menu Items."

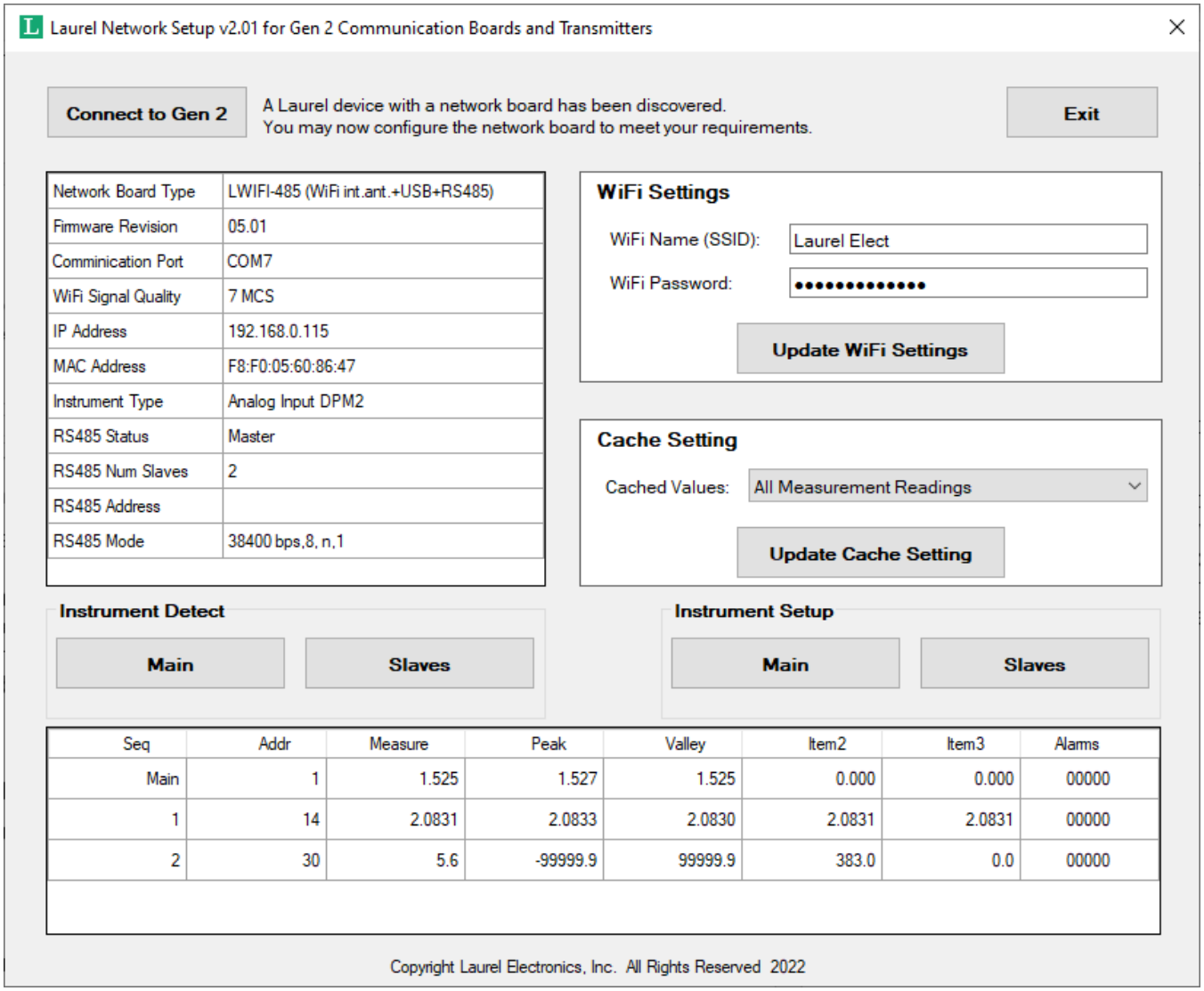
MENU ↵ *Press Menu Select Key*	PEAK ▶ *Press Digit Select Key*	RESET ▲ *Press Value Select Key*
SEr 1 Fixed Parameters: No parity 8 data bits 1 stop bit	**0**00 Output filtering	**0** Send unfiltered signal **1** Send filtered signal
	0**0**0 Baud rate	**0** 300 baud **1** 600 baud **2** 1200 baud **3** 2400 baud **4** 4800 baud **5** 9600 baud **6** **19200 baud**
	00**0** Output update rate	60 Hz / 50 Hz **0** **Line frequency** / **Line frequency** **1** 0.28 sec / 0.34 sec **2** 0.57 sec / 0.68 sec **3** 1.1 sec / 1.4 sec
SEr 2 Serial Setup 2	**0**0000 Line feed	**0** **No line feed after carriage return** **1** Line feed after carriage return
	0**0**00 Alarm data with readings	**0** No alarm data **1** **Alarm data with reading**
	0**0**0**0** Control of data output	**0** Continuous data output **1** **Data output on ASCII command only**
	0**0**0**0** Meter address with Custom ASCII protocol	Select **1** thru **F** for addresses **1** thru 15. Select **0.** thru **F.** (with decimal point) for addresses 16 thru 31.
SEr 3 Serial Setup 346	**0**0000 Half or full duplex	**0** **Half or full duplex** **1** Do not use
	00000 Special start & stop char.	**0** **Standard continuous mode** **1** Special start & stop characters
	00**0**00 RTS mode (for RS232)	**0** **Normal RS232 operation** **1** Single RS232 transmission mode with -e jumper on RS232 board
	0000**0** Termination characters	**0** **Only at end of all items** **1** At end of each item
	0000**0** Data sent in continuous mode	**0** **Reading** **1** Peak **2** Valley **3** Reading + peak **4** Reading + valley **5** Reading + peak + valley

6. LWIFI OR LWIFIX NETWORK SETUP DISCOVERY SCREEN

LWIFI and LWIFIX come with a wireless WiFi connection for use with Modbus TCP/IP commands, a USB port for connection to a PC for programming or data, and an RS485 port which can be connected to a PC or serve as a gateway to an RS485 bus with up to 31 Laureate meters or transmitters.

Upon launch, the Laurel Network Setup (LNS) utility will present you with a blank LNS discovery screen. Click on the “Connect to Gen 2” button in the upper left, and the screen will start to self-populate. Enter the “WiFi Name (SSID)” and “WiFi Password” to show the IP address for Modbus commands and real-time meter readings.

The example below is for LWIFI connected to the PC via a USB cable and with two slave meters connected via RS485. These must have been set up in advance from their front panel for the Custom ASCII protocol, 19200 baud, N81, and an address from 2 to 31. Transmitters must have been set up the same with IS software.



Network Board Type: As programmed into the Gen 2 board and discovered by the LNS utility over USB.

Firmware revision: As programmed into the Gen 2 board and discovered by the LNS utility over USB.

Communication Port: The COM port used by the PC for USB communications to the Gen 2 board, as discovered by the LNS utility.

WiFi Signal Quality: An MCS (Modulation Coding Scheme) score from 0 to 7 to indicate WiFi signal quality. An MCS score of 3 or less indicates low signal quality. An MCS sore of 7 MCS indicates a WiFi data rate of 72.2 Mbits/sec. The MCS score is only displayed after WiFi communications have been established after entering the correct WiFi SSID and password in the upper right of the screen. Otherwise “No Connection” is displayed.

IP Address: As assigned by the network router to the Gen 2 board. With WiFi, the address is always dynamic. The IP address is only displayed after entering the correct WiFi SSID and password in the upper right of the screen. Otherwise “No Connection” is displayed. With Ethernet in lieu of WiFi, the IP address can also be static as assigned by the router. The IP address needs to be known for Modbus WiFi or Ethernet communications.

MAC Address: A unique 12-digit hexadecimal number assigned by the manufacturer to the WiFi or Ethernet chip as discovered by the LNS utility over USB.

Instrument Type: The Laureate instrument type as discovered by the LNS utility over USB.

RS485 Status: “Master” is displayed if the host meter serves as a gateway (or master) to meters on an RS485 bus. “Slave” is displayed if the host meter does not serve as a gateway to meters on an RS485 bus.

RS485 Num Slaves: The number of slave meters from 0 to 31 on the RS485 bus if the host meter serves as a gateway (or master) to meters on an RS485 bus. The number 0 indicates no slaves.

RS485 Address: The Modbus address to be used by Modbus RTU when addressing the host meter as a Modbus slave. The factory default is 1. Modbus commands can be used to assign an address from 1-255 as explained in the Appendix to this manual. The RS485 address is blank if the host meter serves as a Master to one or multiple Slaves on an RS485 bus.

RS485 Mode: The baud rate, data bits, parity and stop bits used for communications with the host meter as a Modbus slave. The factory default is 38400, 8, n, 1. As explained in the Appendix to this manual, the baud rate can be set to 1200, 2400, 4800, 9600, 19200, 28400, 57600 or 115200. Parity can be set to odd, even or none. Stop bits can be set to 1 or 2.

WiFi Settings requires entry of the correct “WiFi Name (SSID)” and “WiFi Password” to enter access the WiFi network. Press “Update WiFi Settings” after you have made

your entries. If your entries are correct, the fields “WiFi Signal Quality” and “IP address” are populated, otherwise “No Connection” is displayed.

Cache Setting: Choices are “Displayed Measurement Only” or “All Measurement Readings.” The first selection only writes the latest measurement into cache and is best for high read rates. The second selection writes 6 values into cache. The 6 values depend on the meter type:

- Analog input meter (model numbers starting with L1-L4):
  alarm status, display value, peak value, valley value, display value, display value.
- Scale/weight meter (model numbers starting with LW):
  alarm status, display value, peak value, net value, gross value, display value.
- Counter/timer (model numbers starting with L5-L8):
  alarm status, display (item 1) value, peak value, valley value, item 2 value, item 3 value.

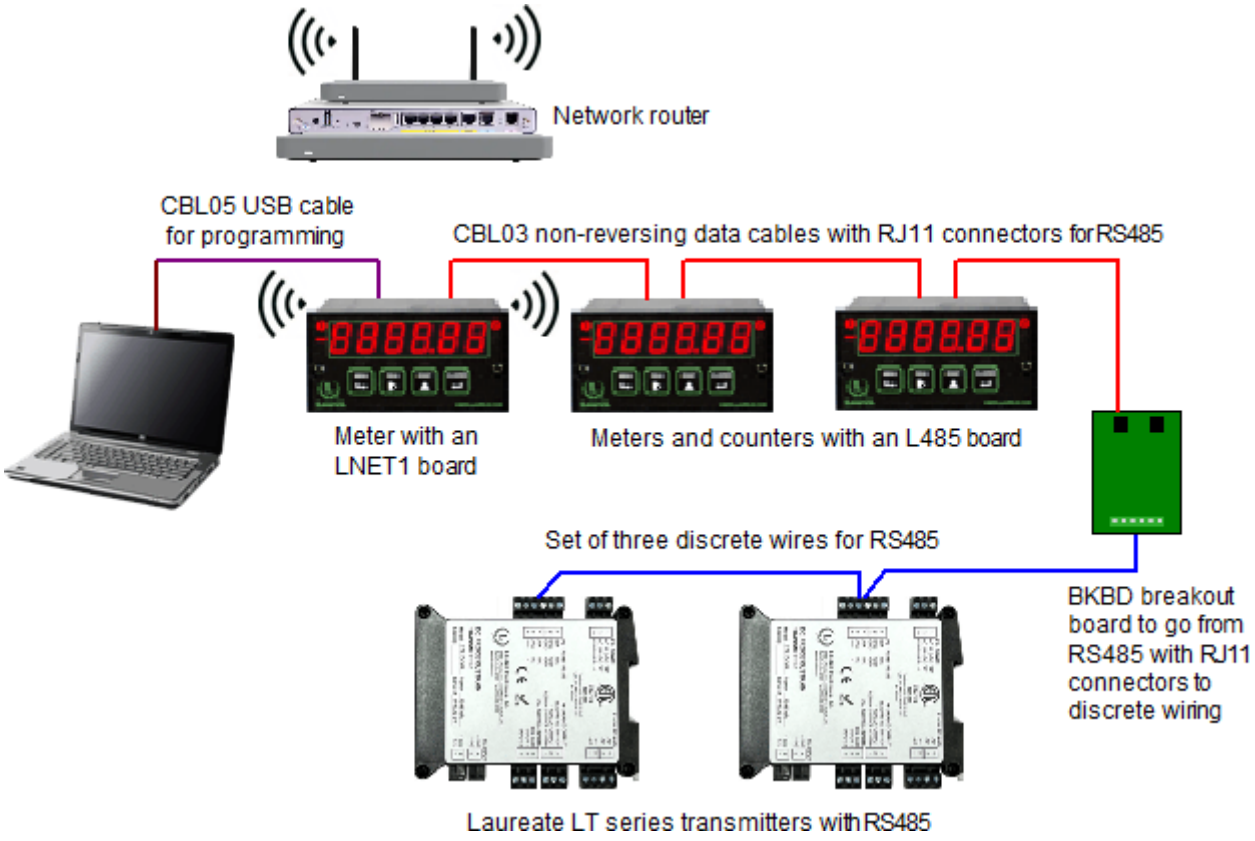
Alarm and overload status are contained in the lower 5 bits of holding registers 7000 and 7800. If a bit is set to 1, the alarm or overload condition exists. If a bit is set to 0, the condition does not exist. Bit 1 is the least significant (or right-most) bit.

- Bit 5 indicates signal overload, like 21V being applied to the 20V range.
- Bit 4 indicates an alarm condition on alarm 4.
- Bit 3 indicates an alarm condition on alarm 3.
- Bit 2 indicates an alarm condition on alarm 2.
- Bit 1 indicates an alarm condition on alarm 1.In the resulting Establish Communications screen, select the COM port discovered by the Network Setup utility and 19200 baud, then click on Establish. After you see “Communications Established,” click on “Main Menu” to enter the main section of IS software.

Instrument Detect: Click on “Main” to repeat discovery of the host (or Main) meter. Click on “Slaves” to repeat discovery of slaves on an RS485 bus connected to the host meter. If “Detect” is not pressed, the last findings are retrieved from EEPROM, thereby saving about 10 seconds. Always press Detect if you have changed your host meter or have added or removed slaves.

The bottom of the LNS screen lists the Main meter (or host meter to the Gen 2 board) plus any discovered Slaves, along with their Modbus address and latest measurements. If “Cache Setting” was set to “All Measurement Readings,” real time entries will also be displayed for Peak, Valley, Item 2, Item 3 and Alarms. Check these values to verify that your network is working as expected.

Shown below is an example of a network which includes a Main meter with an LWIFI communication board, two Slave meters on RS485 bus, and two Slave transmitters on the same RS485 bus. In this example, the LWIFI USB port is used with Laurel Network Setup (LNS) software to enter the WiFi SSID and password, and to discover the LWIFI board's IP address. Measurement data is transferred to a PC or HMI (not shown) which is connected to the router either via an Ethernet cable or wirelessly.

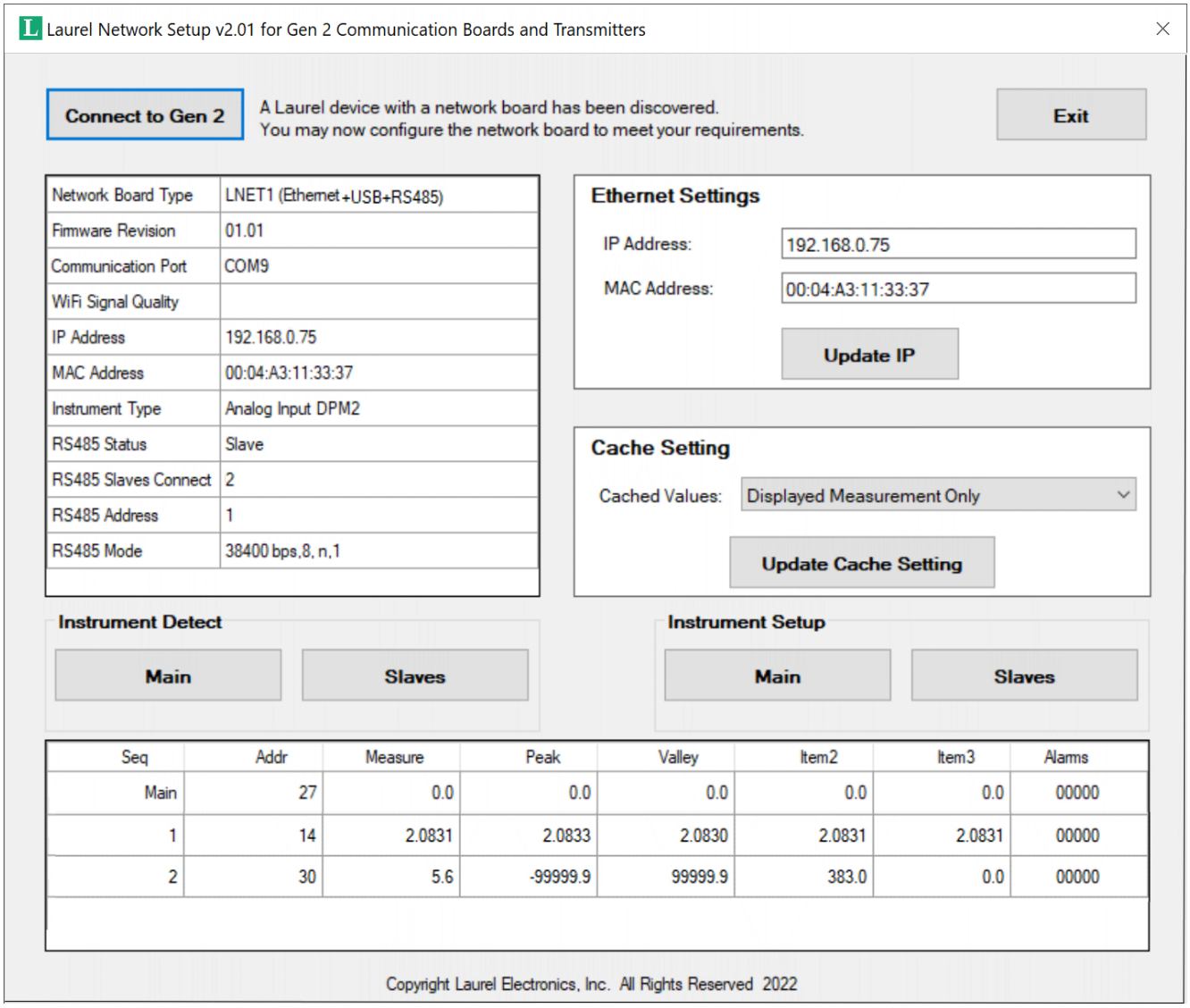


7. LNET1 NETWORK SETUP DISCOVERY SCREEN

LNET1 comes with an Ethernet connection for use with Modbus TCP/IP commands, a USB port for connection to a PC for programming or data, and an RS485 port which can be connected to a PC or serve as a gateway to an RS485 bus with up to 31 Laureate meters or transmitters.

Upon launch, the Laurel Network Setup (LNS) utility will present you with a blank LNS discovery screen. Click on the “Connect to Gen 2” button in the upper left, and the screen will self-populate.

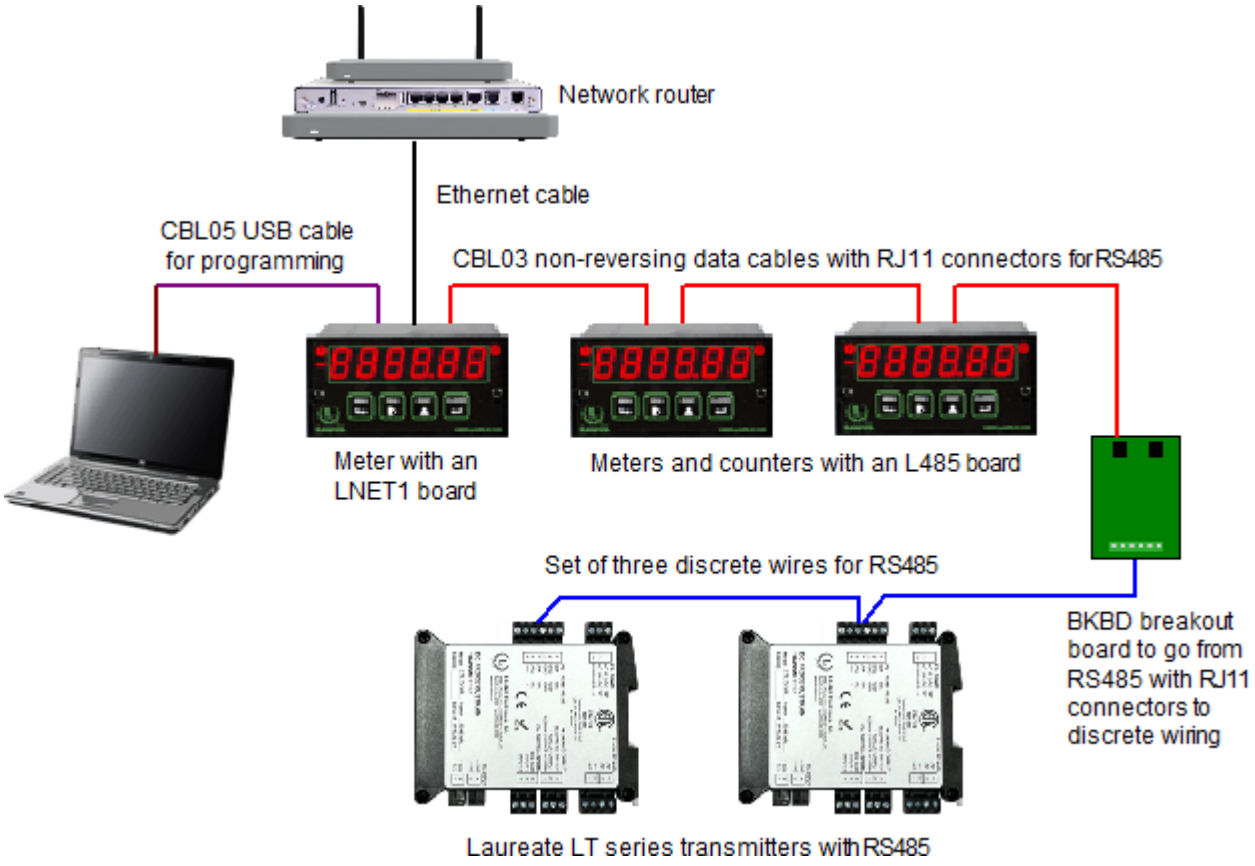
The example below is for an LNET1 board connected to the PC via a USB cable and with two slave meters connected via RS485. The slave meters must have been set up in advance from their front panel for the Custom ASCII protocol, 19200 baud, N81, and an address from 2 to 31. Transmitters must have been set up the same with IS software.



The discovery screen for LNET1 is as described in the previous manual section for LWIFI and LWIFIX, except that there are no entries for WiFi signal quality, WiFi Name or WiFi Password.

If the Ethernet network router has DHCP, the IP address shown is that assigned by the router. If the router does not have DHCP, you can enter an IP address manually under “Ethernet Settings” and press “Update IP.”

Shown below is an example of a network which includes a Main meter with an LTNET1 communication board, two Slave meters on RS485 bus, and two Slave transmitters on the same RS485 bus. In this example, the LTNET1’s USB port is used for IP address discovery using Laurel Network Setup (LNS) software. Measurement data is transferred to a PC or HMI (not shown) which is connected to the router either via an Ethernet cable or wirelessly. Use of an LWIFI or LWIFIX board in the Main meter would remove the Ethernet cable from the Main meter to the router.



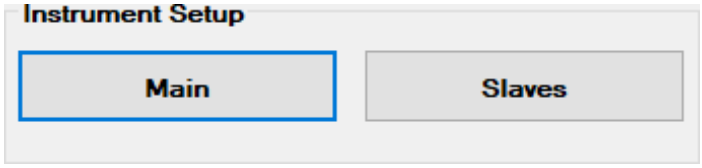
LTNET1 supporting meters and transmitters on an RS485 bus

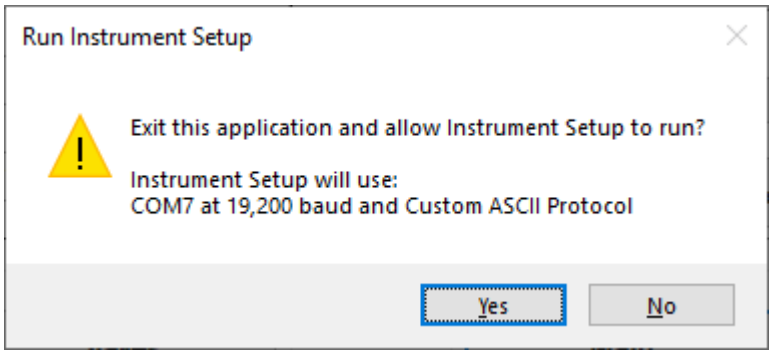
8. INSTRUMENT SETUP SOFTWARE WITH GEN 2 BOARDS

Instrument Setup (IS) software is a free PC based Windows graphical user interface (GUI) with pull-down menus that can be used as an alternative to front panel programming for Laureate meters. It saves time and avoids human error when multiple meters are to be programmed in the same way. Please see our separate Instrument Setup (IS) Software Manual. The procedure in this section applies to an LWIFI, LWIFIX or LNET1 Gen 2 board which is connected via USB to a PC on which LNS and IS software have been installed.

1. IS software with the Gen 2 host (or Main) Meter

To apply IS software to the host or "Main" meter of the Gen 2 board from the LNS discovery screen, click on "Main" under "Instrument Setup." You will be prompted to click on "Yes" to exit the LNS utility and launch IS software.



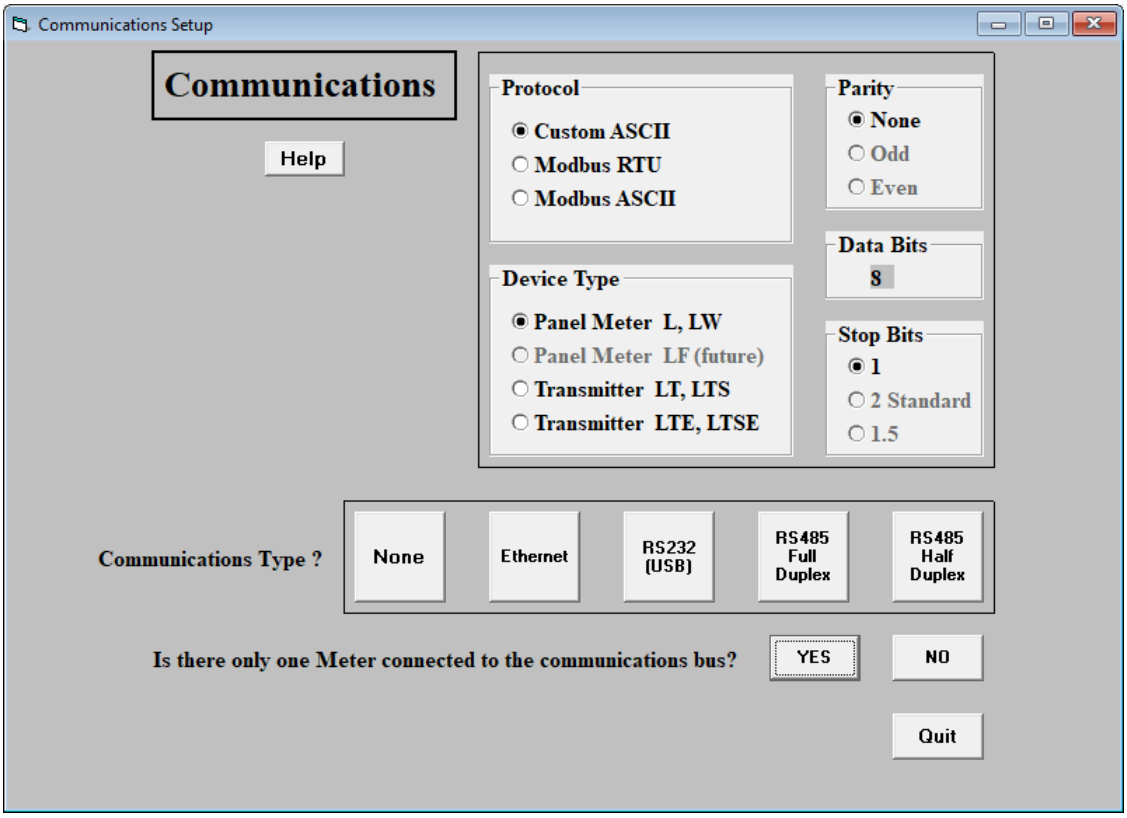


In the "Communications Setup" screen of IS software, select the "Custom ASCII" protocol, click on "RS485 Full Duplex," and click on "Yes" to indicate that there is only one meter on the RS485 bus.

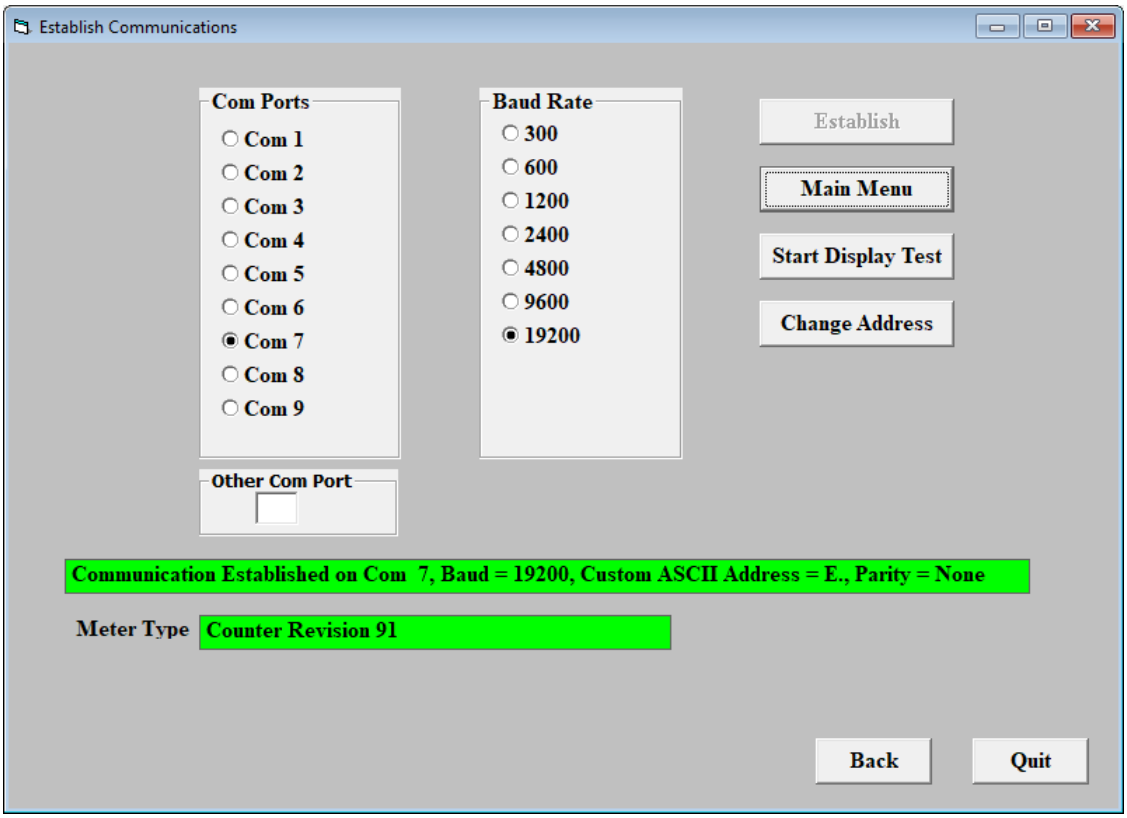
In the "Establish Communications" screen, select the COM port discovered by the LNS utility and 19200 baud. Click on "Establish" to establish communications. Two lines highlighted in green should appear at the bottom of the screen to indicate success. Click on "Main Menu" to enter main IS software screens.

To get started with IS software, click on "DPM" or "Counter" in the top menu bar and then on "Get Setup" to upload setup information from the DPM our Counter to your PC. Click on "Put Setup" to download any changes to your PC.

You must recycle power to the host (or Main) meter to reenter the LNS utility after running IS software, or the LNS utility will return the message "No Network Board Found."



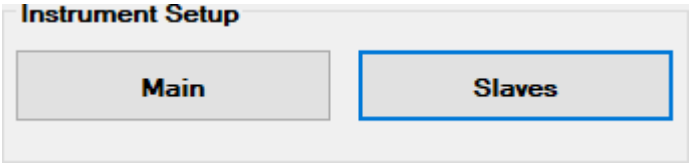
IS software Communication Setup screen for host (or Main) meter.

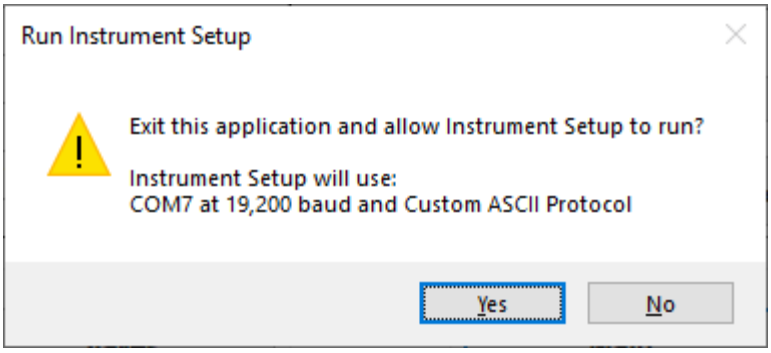


IS software Establish Communications screen for Main or Slave meters.

2. IS software with RS485 Slaves

To apply IS software to Slave meters or transmitters on the RS485 bus connected to a Gen2 LWIFI, LWIFIX or LNET1 board from the LNS discovery screen, click on “Slaves” under “Instrument Setup.” You will be prompted to click on “Yes” to exit the LNS utility and launch IS software.”



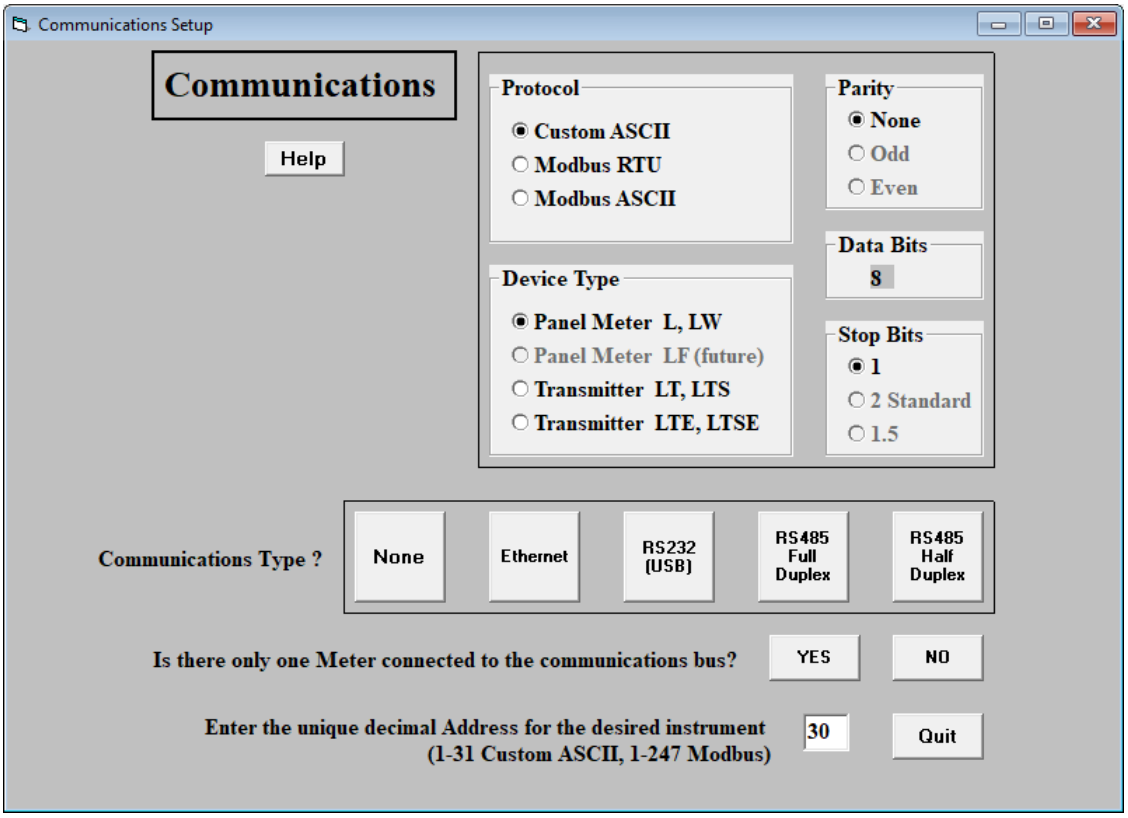


In the “Communications Setup” screen of IS software, select the “Custom ASCII” protocol, click on “RS485 Full Duplex,” click on “No” to indicate that there are multiple meters on the RS485 bus, enter the address 1-31 of the meter to be programmed, and press Enter.

The resulting “Establish Communications” screen will be as for the host (or Main) meter. Select the COM port discovered by the LNS utility and 19200 baud. Click on “Establish” to establish communications. Two lines highlighted in green should appear at the bottom of the screen to indicate success. Click on “Main Menu” to enter main IS software screens.

To get started, click on “DPM” or “Counter” and then on “Get Setup” to upload setup information from the DPM our Counter to your PC. Click on “Put Setup” to download any changes to your PC.

You must recycle power to the host (or Main) meter to reenter the LNS utility after running IS software, or you will get the message “No Network Board Found.”



IS software Communication Setup screen for Slaves.

3. Using Modbus commands to program meters on the fly

While IS software is great for initial setup of a meter, it is not suitable for changing operating parameters during normal meter operation. Examples of parameters to be changed “on the fly” are setpoints for relay action.

Operating parameters can be changed with Modbus commands. With only a few exceptions, these can modify all setup parameters entered via a meter’s front panel or via Instrument Setup (IS) software. A warning is that changing any parameter in non-volatile memory of a Laureate meter causes a meter reset. During reset, normal meter operation is suspended, and the word “Reset” may flash one or multiple times.

9. DATA CACHING, DATA RATES & READ RATES

Cached operation is a key feature of LWIFI, LWIFIX and LNET1 Gen 2 communication boards. It allows much faster command mode operation than for Gen 1 communication boards. The use cache decouples the rate at which the Gen 2 board can poll its host meter as a Master from the rate at which the Gen 2 board can be polled as a Slave by external Modbus commands.

If the host meter is an analog input meter, a Gen 2 board can get updated readings from its host meter as fast as every **16.666 msec** if the meter is set for 60 Hz noise rejection or every **20.000 msec** if the meter is set for 50 Hz noise rejection. Note that every 17th reading is not updated since the meter then zeroes itself.

If the host meter is a counter set to frequency or rate mode, a Gen 2 board can get updated readings from its host meter every programmed gate time from 10 msec to 199.99 sec + 30 msec + 0-2 signal periods.

The fastest rate at which updated values can be read via external Modbus commands is paced by the measurement update intervals of the meter. Unchanged values are read by the external Modbus Master when data is read from cache at a rate faster than that at which readings are updated into cache.

Single values written into cache can be retrieved via WiFi, Ethernet, USB or RS485 using Modbus commands at these maximum rates:

- Ethernet: every 2 msec
- WiFi: every 10 msec
- USB: every 10 msec (at 38400 baud)
- RS485: every 5 msec (at 115200 baud)

A set of 6 analog values are written into cache every **100 msec** (60 Hz filtering) or **120 msec** (50 Hz filtering) if the "Cache Setting" is set to "All Measurements."

USB communications between an LWIFI, LWFIX or LNET1 board and an external Modbus Master use the Modbus RTU protocol, 38400 baud and address 1. These parameters cannot be changed.

WiFi communications between an LWIFI or LWFIX board and an external Modbus Master use the Modbus TCP protocol at a baud rate allowed by IEEE 802.11 b/g/n.

Ethernet communications between an LNET1 or LNET-485 board and an external Modbus Master use the Modbus TCP protocol at a 10 or 100 Mbits/sec.

System-internal communications between a Gen 2 board and its host meter use the Custom ASCII protocol, 19200 baud, N81, and address 1. These parameters need to be entered into the host meter from its front panel or with IS software.

System-internal communications between a Gen 2 board and Slave meters on an RS485 bus use the Custom ASCII protocol, 19200 baud, and N81. These parameters and the meter address need to be entered into each Slave meter in advance.

10. GEN 2 MODBUS IMPLEMENTATION

1. Modbus Protocol Overview

The Modbus protocol is used for external commands with Gen 2 communication boards, not Laurel's Custom ASCII protocol or the Ethernet/IP protocol. The same Modbus function codes and registers apply to Modbus TCP, which is used with Ethernet or WiFi, and to Modbus RTU, which is used with USB or RS485.

The Gen 2 Modbus protocol implementation described in this manual is simpler than that for Laurel's legacy Gen 1 boards. However, all Gen 1 Modbus protocol commands also work with Gen 2 boards. Please see our Gen 1 Modbus Protocol Communications Manual, Analog Input and our Gen 1 Modbus Protocol Communications Manual, Pulse Input.

Modbus is a master/slave protocol, where a master writes data to a slave's registers and reads data from a slave's registers. A register is a memory location. A master is a device like a PC or PLC that initiates requests. A slave is typically an instrument, like a Laurel meter, that responds to requests. A slave cannot initiate requests. Each slave that is addressed over an Ethernet or WiFi network has an IP address and will only respond if addressed. A slave that is connected via USB has address 1 since USB is not designed for multipoint addressing.

- **A Holding Register** is a 16-bit memory location that may be read or written. If a 32-bit value is to be held in Holding Registers, two 16-bit register addresses must be specified.
- **A Coil** is a 1-bit memory location that is used to control a specific outcome. It may be read or written.
- **An Input Register** is a 16-bit register that may only be read.

Decimal memory addresses are stated in this manual, not hexadecimal. Use an online tool to switch from decimal to hexadecimal if required.

Base 1 memory addresses are stated in this manual, not Base 0. With Base 1, numbering starts with 1, not 0. To switch from Base 1 to Base 0, add 1 to the address.

A Function Code specifies the type of register. The following Function Codes are described in this manual:

- **FC01** is used to read multiple 1-bit coils.
- **FC03** is used to read multiple16-bit holding registers.
- **FC04** is used to read multiple 16-bit input registers.
- **FC05** is used to write to a single 1-bit coil.
- **FC0F** is used to write to multiple 1-bit coils.
- **FC06** is used to write to a single 16-bit holding register.
- **FC10** is used to write to multiple 16-bit holding registers.

Signed integers in two's complement format are binary numbers where the most significant (or leftmost) bit represents a minus sign when it is a 1. See Wikipedia for a more detailed description.

2. Gen 2 Reading the Display Value with Cached "Displayed Measurement Only"

If the Network Setup utility is set to cache "Displayed Measurement Only," the cached meter reading will be available for retrieval via Modbus every 10 msec.

Use the table below if the reading is desired as a 32-bit signed two's complement integers with a separately read decimal point.

Funct. Code	Input Register Base 1 Address	Register Contents	Data Format
FC04	0105	Read decimal point position	0001 = xxxxxx. 0002 = xxxxx.x 0003 = xxxx.xx 0004 = xxx.xxx 0005 = xx.xxxx 0006 = x.xxxxx
FC03	7400-7401	Low address is most significant word. High address is least significant word.	Combine 16-bit words to form a 32-bit integer.

Use the table below applies if the reading is desired as a 32-bit real number in IEEE 754 floating point format.

Funct. Code	Input Register Base 1 Address	Holding Register Contents	Data Format
FC03	8200-8201	Low address is most significant word. High address is least significant word.	Combine 16-bit words to form a 32-bit floating point number.

3. Gen 2 Reading Six Parameters with Cached "All Measurements"

If the Network Setup utility is set to cache "All Measurements," six readings will be available for retrieval via Modbus every 100 msec.

Use the table below if readings are desired as 32-bit signed two's complement integers with a separately read decimal point.

Funct. Code	Input Register Base 1 Address	Register Contents	Data Format
FC04	0105	Read decimal point position	0001 = xxxxxx. 0002 = xxxxx.x 0003 = xxxx.xx 0004 = xxx.xxx 0005 = xx.xxxx 0006 = x.xxxxx
FC03	7000	Alarm and overload status in bits 1-5: - - - - - - - - - - - 5 4 3 2 1	Bit 1 = Alarm 1 Bit 2 = Alarm 2 Bit 3 = Alarm 3 Bit 4 = Alarm 4 Bit 5 = Overload
FC03	7002-7003	Display measurement value	Low address is most significant word. High address is least significant word. Combine 16-bit words to form a 32-bit integer.
FC03	7004-7005	Peak Value	
FC03	7006-7007	Valley value for analog DPMs. Net weight for scale meters. Valley for counter/timers.	
FC03	7008-7009	Display value for analog DPMs. Gross weight for scale meters. Item 2 for counter/timers.	
FC03	7010-7011	Display value for analog DPMs. Display value for scale meters. Item 3 for counter/timers.	

Use the table below applies if readings are desired as 32-bit real numbers in IEEE 754 floating point format.

Funct. Code	Input Register Base 1 Address	Holding Register Contents	Data Format
FC03	7800	Alarm and overload status in bits 1-5: - - - - - - - - - - - - 5 4 3 2 1	Bit 1 = Alarm 1 Bit 2 = Alarm 2 Bit 3 = Alarm 3 Bit 4 = Alarm 4 Bit 5 = Overload
FC03	7802-7803	Display measurement value	Low address is most significant word. High address is least significant word. Combine 16-bit words to form a 32-bit floating point number.
FC03	7804-7805	Peak Value	
FC03	7806-7807	Valley value for analog DPMs. Net weight for scale meters. Valley for counter/timers.	
FC03	7808-7809	Display value for analog DPMs. Gross weight for scale meters. Item 2 for counter/timers.	
FC03	7810-7811	Display value for analog DPMs. Display value for scale meters. Item 3 for counter/timers.	

4. Gen 2 Reading and Writing DPM Relay Setpoints, Scale and Offset

Use the table below to read or write these Holding Registers. Use Function Code FC03 to read, and Functions codes FC06 or FC10 to write. Any read or write involving these registers will cause the meter to reset.

Input Register Base 1 Address	Holding Register Contents	Data Format
0502-0503	Setpoint 1 value	Low address is most significant word. High address is least significant word. Combine 16-bit words to form a 32-bit signed integer in 2's complement format.
0504-0505	Setpoint 2 value	
0506-0507	Setpoint 3 value	
0508-0509	Setpoint 4 value	
0510-0511	Scale factor value	
0512 & 0517	Offset value	

5. Gen 2 Reading and Writing to Coils

Coils are 1-bit memory addresses that are used to control specific outcomes. They may be read or written. Use Function Code FC01 to read. Use Function Codes FC05 or FC0F to write. Any write involving these coils will cause the meter to reset.

Analog input DPM & Scale/Weight Meter	Coil #
Cold reset	1
skipped	2
Latched alarms reset	3
Peak value reset	4
Remote display reset	5
External Input B true	6
External Input B false	7
External Input A true	8
External Input A false	9
Valley reset	10
Tare function	11
Tare reset	12

Pulse Input Counter/Timer	Coil #
Cold reset	1
Function reset	2
Latched alarms reset	3
Peak value reset	4
Remote display reset	5
External Input B true	6
External Input B false	7
External Input A true	8
External Input A false	9
Valley value reset	10
Store totals & reset	11

6. Gen 2 Non-Volatile Memory Addresses for Advanced Reading or Writing

Use Function Code FC03 to read and Function Codes FC06 or FC10 to write. Any read or write to these registers causes a meter reset.

	Byte 3			Byte 2	Byte 1	
Magnitude (Mag)	XXXX XXXX			XXXX XXXX	XXXX XXXX	S = Sign Sign = 1 for negative DP = 1 for DDDDDD. DP = 6 for D.DDDDD
Sign + Magnitude (S+M)	X	XXX XXXX		XXXX XXXX	XXXX XXXX	
	S	Magnitude				
Sign + DP + Magnitude (S+DP+M)	X	XXX	XXXX	XXXX XXXX	XXXX XXXX	
	S	DP	Magnitude			
2's Complement (2's C)	XXXX XXXX			XXXX XXXX	XXXX XXXX	

DPM NONVOLATILE MEMORY ADDRESSES (2 bytes/address)

Gen 2 DPM Non-volatile Memory Addresses (2 bytes/address)

Dec Addr	MS Byte	LS Byte	Stored As
617	Setup1	Serial Confg3	Bits
616	Deviation4 Byte 3	Deviation4 Byte 2	Magnitude
615	Deviation4 Byte 1	Deviation3 Byte 3	Magnitude
614	Deviation3 Byte 2	Deviation3 Byte 1	Magnitude
613	Setpoint4 Byte 3	Setpoint4 Byte 2	2's Complement
612	Setpoint4 Byte 1	Setpoint Byte 3	2's Complement
611	Setpoint3 Byte 2	Setpoint3 Byte 1	2's Complement
610	Alarm Cnfg4	Alarm Confg 3	Bits
609	Version (read only)	M Type (read only)	Byte
554	Tare Setup	Analog Type	Bits
558	Serial Cnfg4 (Bits)	Modbus Address (Byte)	
524	Deviation2 Byte 3	Deviation2 Byte 2	Magnitude
523	Deviation2 Byte 1	Deviation1 Byte 3	Magnitude
522	Deviation1 Byte 2	Deviation1 Byte 1	Magnitude
521	Configuration	Sig Cond Type (do not change)	Bits
520	Analog Setup	System Decimal Point	Bits
519	Lockout2	Lockout1	Bits
518	Serial Cnfg2	Serial Cnfg1	Bits
517	Options	Filter	Bits
516	Setup	Input Type	Bits
515	Alarm Cnfg Byte 2	Alarm Cnfg1	Bits
514	Analog High Byte 3	Analog High Byte 2	2's Complement
513	Analog High Byte 1	Analog Low Byte 3	2's Complement
512	Analog Low Byte 2	Analog Low Byte 1	2's Complement
511	High Read Byte 3	High Read Byte 2	2's Complement
510	High Read Byte 1	High In Byte 3	2's Complement
509	High In Byte 2	High In Byte 1	2's Complement
508	Low Read Byte 3	Low Read Byte 2	2's Complement
507	Low Read Byte 1	Low In Byte 3	2's Complement
506	Low In Byte 2	Low In Byte 1	2's Complement
505	Offset Byte 3	Offset Byte 2	2's Complement
504	Offset1 (2's Comp)	Scale Factor3 (Sign+DP+Mag)	
503	Scale Factor2	Scale Factor1	Sign+DP+Mag
502	Setpoint2 Byte 3	Setpoint2 Byte 2	2's Complement
501	Setpoint2 Byte 1	Setpoint1 Byte 3	2's Complement
500	Setpoint1 Byte 2	Setpoint1 Byte 1	2's Complement

Gen 2 Counter/Timer Non-volatile Memory Addresses (2 bytes/address)

Dec Addr	MS Byte of NV RAM	Stored As	LS Byte of NV RAM	Stored As
616	Deviation4 Byte 3	Mag	Deviation4 Byte 2	Mag
615	Deviation4 Byte 1	Mag	Deviation3 Byte 3	Mag
614	Deviation3 Byte 2	Mag	Deviation3 Byte 1	Mag
613	Setpoint4 Byte 3	2's C	Setpoint4 Byte 2	2's C
612	Setpoint4 Byte 1	2's C	Setpoint3 Byte 3	2's C
611	Setpoint3 Byte 2	2's C	Setpoint3 Byte 1	2's C
610	Alarm Confg4	Bits	Alarm Confg3	Bits
609	Version (read only)	Byte	M Type (read only)	Byte
608	T Stop	Byte	T Start	Byte
607	R Show	Byte	R Skip	Byte
606	R Stop	Byte	R Start	Byte
553	Analog High2 Byte 3	2's C	Analog High2 Byte 2	2's C
552	Analog High2 Byte 1	2's C	Analog Low2 Byte 3	2's C
551	Analog Low3 Byte 2	2's C	Analog Low2 Byte 1	2's C
550	Serial Confg4	Bits	Modbus Address	Byte
548	Total A Byte 6	Mag	Total A Byte 5	Mag
548	Total A Byte 4	Mag	Total A Byte 3	Mag
547	Total A Byte 2	Mag	Total A Byte 1	Mag
546	Total B Byte 6	Mag	Total B Byte 5	Mag
545	Total B Byte 4	Mag	Total B Byte 3	Mag
544	Total B Byte 2	Mag	Total B Byte 1	Mag
542	Do not use	---	Analog Type	Bits
541	Cutoff Byte 2	Mag	Cutoff Byte 1	Mag
540	Recog Character	Byte	System Decimal Point	Bits
539	Do not use	Bits	Resolution	Bits
538	Display Item	Bits	Slope	Bits
537	Pulses Byte 2	Mag	Pulses Byte 1	Mag
536	Scale Multiplier	Bits	Analog Output Setup	Bits
535	Source	Bits	Batch	Bits
534	Timeout Byte 2	Mag	Timeout Byte 1	Mag
533	Gate Time Byte 2	Mag	Gate Time Byte 1	Mag
532	Lockout2	Bits	Lockout1	Bits
531	Config	Bits	Serial Config3	Bits
530	Serial Config2	Bits	Serial Config1	Bits
529	Options	Bits	Filter	Bits
528	Setup	Bits	Input Type	Bits
527	Alarm Config 2	Bits	Alarm Config1	Bits
526	Analog High Byte 3	2's C	Analog High Byte 2	2's C

525	Analog High Byte 1	2's C	Analog Low Byte 3	2's C
524	Analog Low Byte 2	2's C	Analog Low Byte 1	2's C
523	Deviation 2 Byte 3	Mag	Deviation2 Byte 2	Mag
522	Deviation 2 Byte 1	Mag	Deviation1 Byte 3	Mag
521	Deviation 1 Byte 2	Mag	Deviation1 Byte 1	Mag
520	Offset2 Byte 3	2's C	Offset2 Byte 2	2's C
519	Offset2 Byte 1	2's C	Scale2 Byte 3	S+M
518	Scale2 Byte 2	S+M	Scale2 Byte 1	S+M
517	Offset1 Byte 3	2's C	Offset1 Byte 2	2's C
516	Offset1 Byte 1	2's C	Scale1 Byte 3	S+M
515	Scale1 Byte 2	S+M	Scale1 Byte 1	S+M
514	Setpoint2 Byte 3	2's C	Setpoint2 Byte 2	2's C
513	Setpoint2 Byte 1	2's C	Setpoint1 Byte 3	2's C
512	Setpoint1 Byte 2	2's C	Setpoint1 Byte 1	2's C
511	High Read2 Byte 3	2's C	High Read2 Byte 2	2's C
510	High Read2 Byte 1	2's C	High In2 Byte 3	S+DP+M
509	High In2 Byte 2	S+DP+M 2's	High In2 Byte 1	S+DP+M
508	Low Read2 Byte 3	C	Low Read2 Byte 2	2's C
507	Low Read2 Byte 1	2's C	Low In2 Byte 3	S+DP+M
506	Low In2 Byte 2	S+DP+M 2's	Low In2 Byte 1	S+DP+M
505	High Read1 Byte 3	C	High Read1 Byte 2	2's C
504	High Read1 Byte 1	2's C	High In1 Byte 3	S+DP+M
503	High In1 Byte 2	S+DP+M	High In1 Byte 1	S+DP+M
502	Low Read1 Byte 3	2's C	Low Read1 Byte 2	2's C
501	Low Read1 Byte 1	2's C	Low In1 Byte 3	S+DP+M
500	Low In1 Byte 2	S+DP+M	Low In1 Byte 1	S+DP+M

Gen 2 Scale/Weight Meter Non-volatile Memory Addresses (2 bytes/address)

Dec Address	MS Byte	LS Byte
529	Tare3	Tare2
528	Tare1	Spare
527	Serial Cnfg 3	Count
524	Setpoint2 Diff 3	Setpoint2 Diff 2
523	Setpoint2 Diff 1	Setpoint1 Diff 3
522	Setpoint1 Diff 2	Setpoint1 Diff 1
521	Configuration	Signal Conditioner Type (do not change)
520	Analog Setup	System Decimal Point
519	Lockout 2	Lockout 1
518	Serial Cnfg 2	Serial Cnfg 1
517	Options	Filter
516	Setup	Input Type
515	Alarm Cnfg 2	Alarm Cnfg 1
514	Analog High 3	Analog High 2
513	Analog High 1	Analog Low 3
512	Analog Low 2	Analog Low 1
511	High Reading 3	High Reading 2
510	High Reading 1	High Input 3
509	High Input 2	High Input 1
508	Low Reading 3	Low Reading 2
507	Low Reading 1	Low Input 3
506	Low Input 2	Low Input 1
505	Offset 3	Offset 2
504	Offset 1	Scale Factor 3
503	Scale Factor 2	Scale Factor 1
502	Setpoint2 3	Setpoint2 2
501	Setpoint2 1	Setpoint1 3
500	Setpoint 1 2	Setpoint1 1
553	Serial Cnfg 4	Modbus Address
554	Spare	Analog Output Type

11. DIAGNOSTIC TOOL QMODMASTER

1. About QModMaster

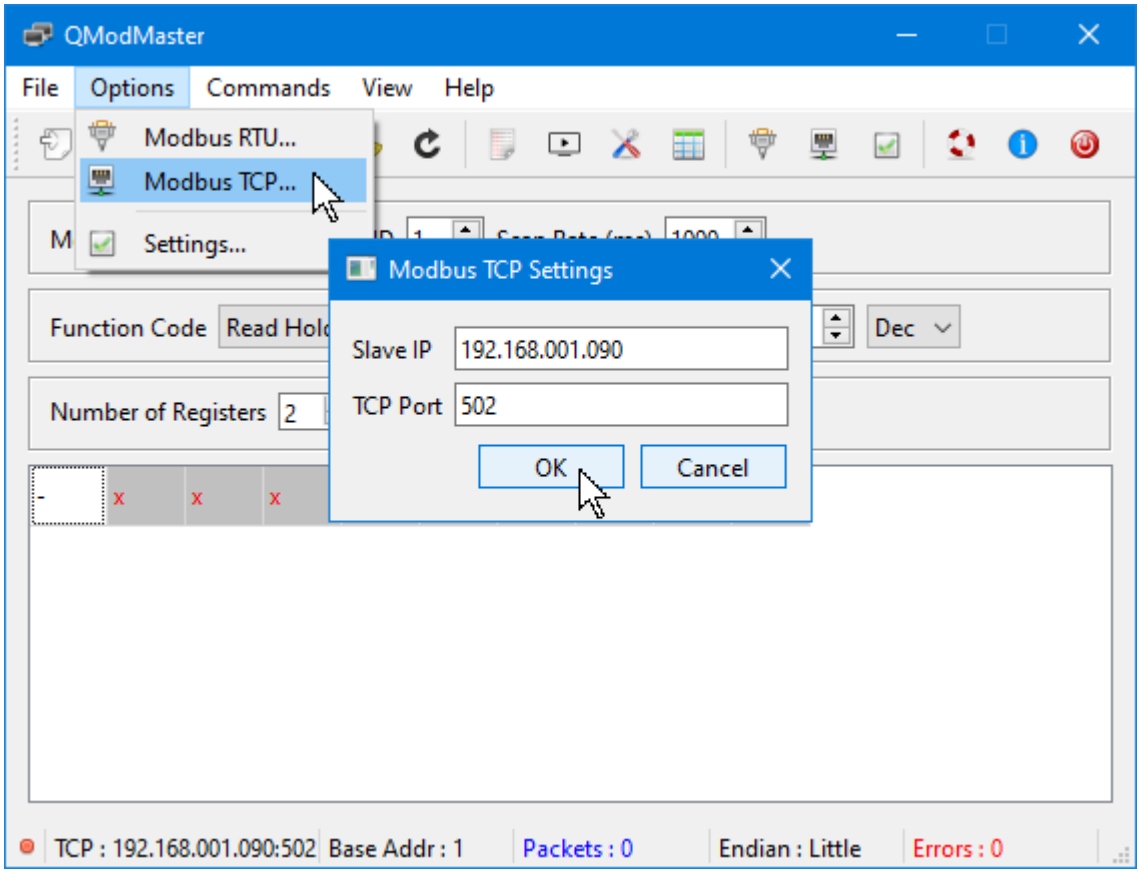
QModMaster.exe is a freeware Windows program which allows a PC to serve as a Modbus Master. It is an easy tool to verify communications, send requests to Modbus Slaves, and view their responses. The current version handles Base 1 and allows the viewing of IEEE 754 floating point values.

2. QModMaster Download and Launch

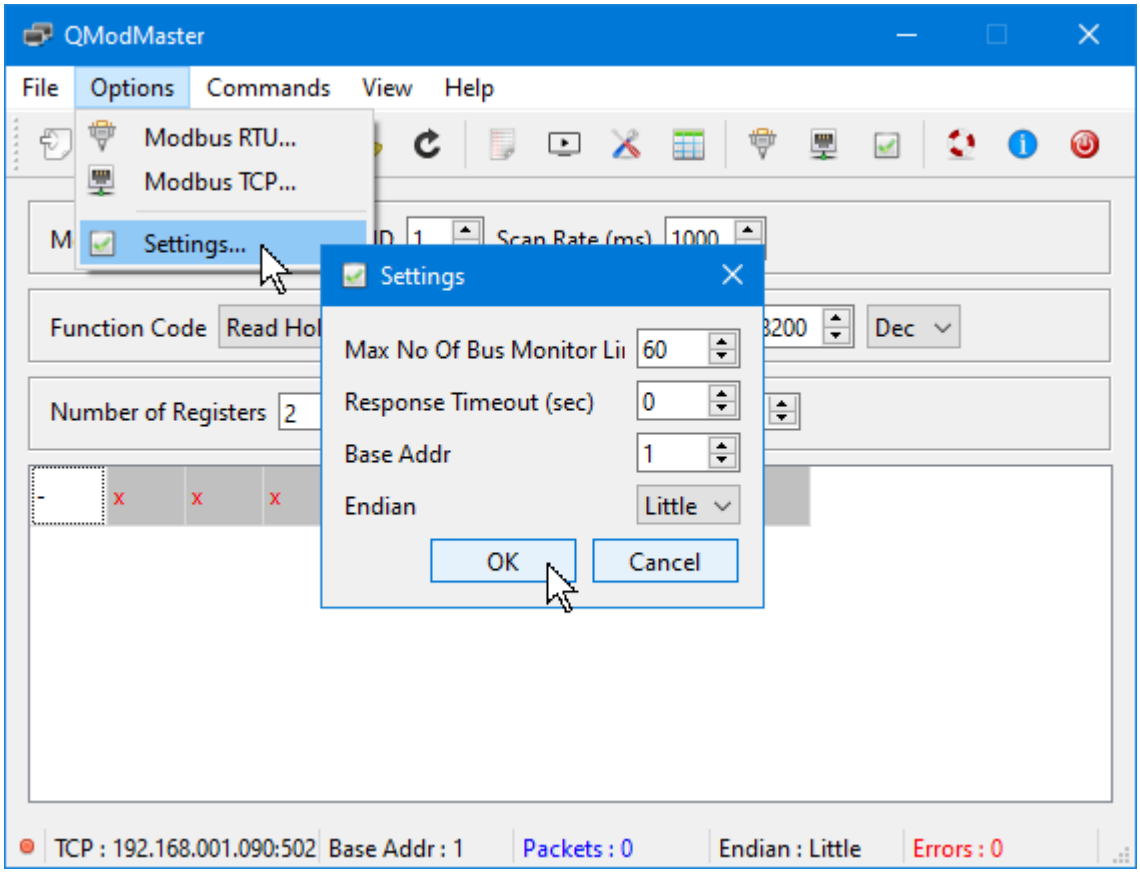
Download QModMaster-Win64-exe-0.5.3-beta.zip from https://sourceforge.net/projects/qmodmaster/files/latest/download and copy it into a directory of your choice. Do an “Extract All” to unzip it. The executable file will be QModMaster.exe. Click on it to launch QModMaster. You may wish to create a shortcut to that file.

3. QModMaster Configuration

a. The first step is to click on *Options* > *Modbus TCP.* In the *Modbus TCP Settings* dialog window, enter the IP address of the LWIFI and click on *OK*.



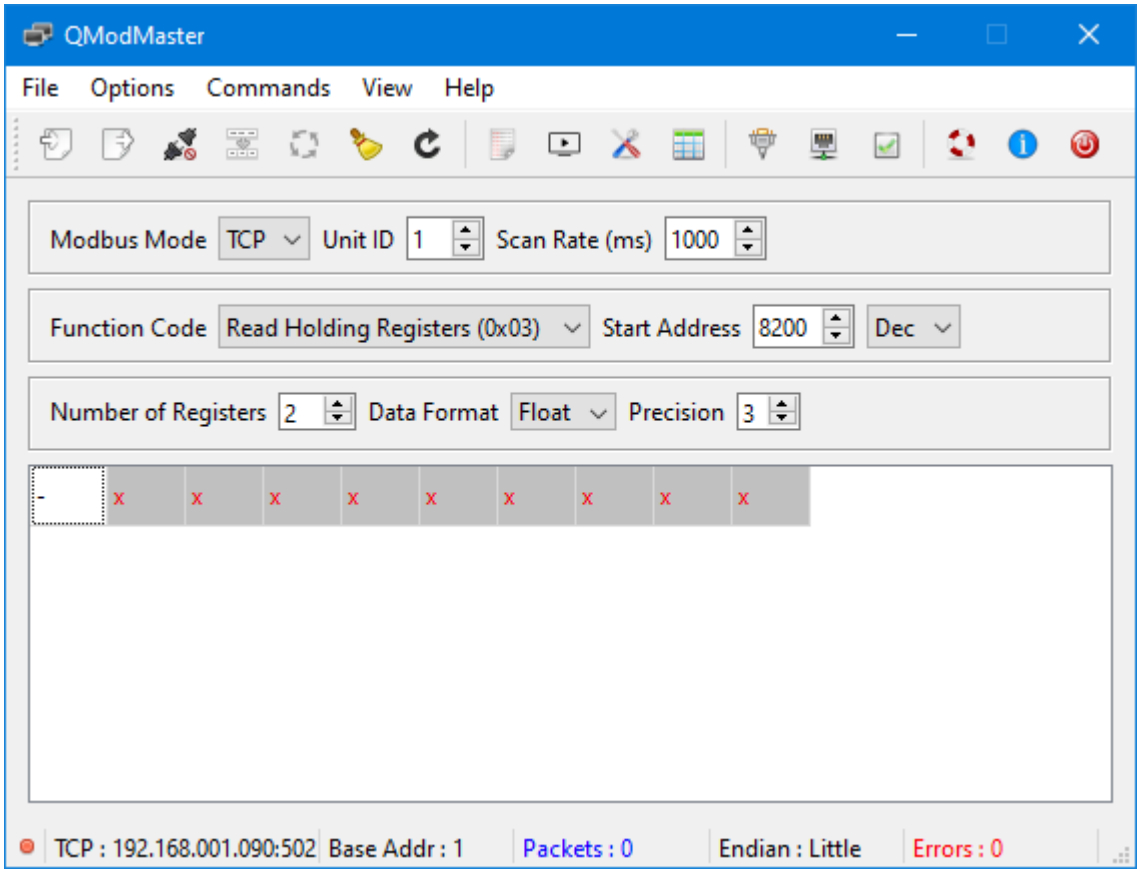
b. The second step is to click on *Options* > *Settings*. In the *Settings* dialog window, ensure that everything is configured as shown and click on *OK*. These are the default settings:



4. Example 1: Obtaining a Floating Point Measurement from a DC Voltmeter

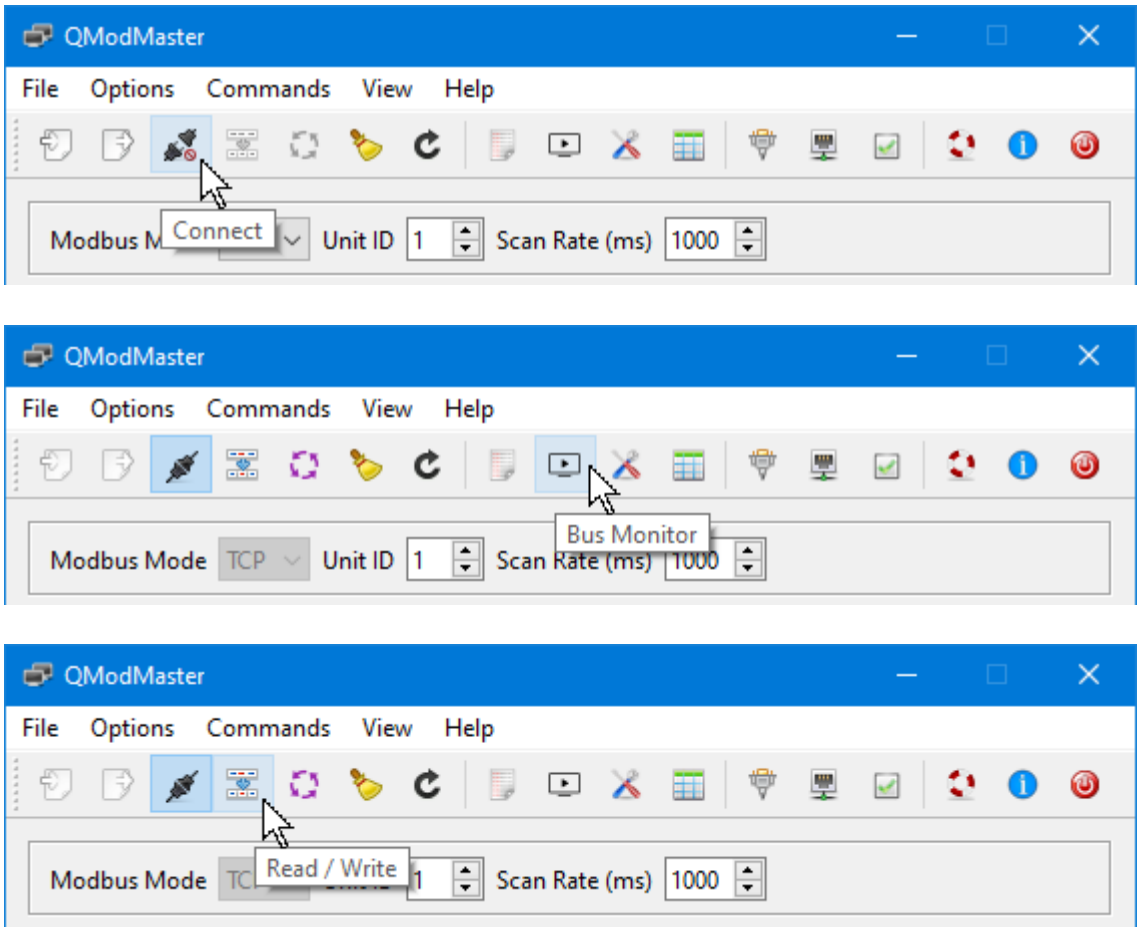
The screen capture below demonstrates the setup to read the currently displayed measurement in floating point format. The critical items are:

- Modbus Mode = **TCP**
- Function Code = **Read Holding Registers (0x03)**
- Start Address = **8200** (dec)
- Number of Registers = **2**
- Data Format = **Float**

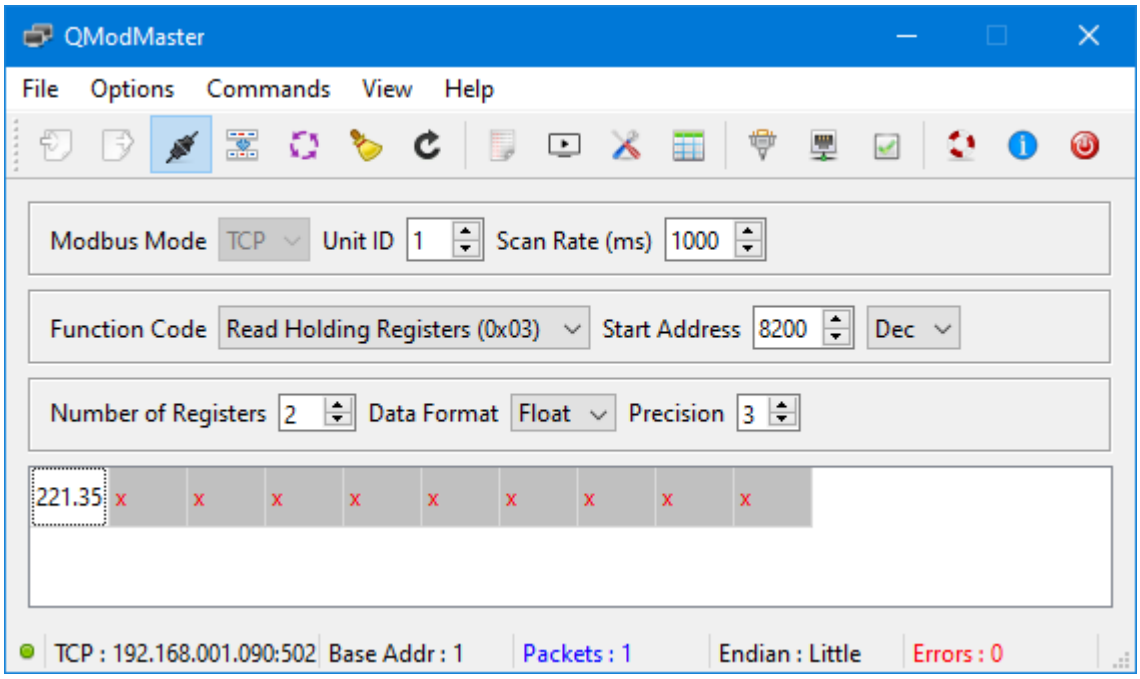


After QModMaster has been set up to read the floating point value:

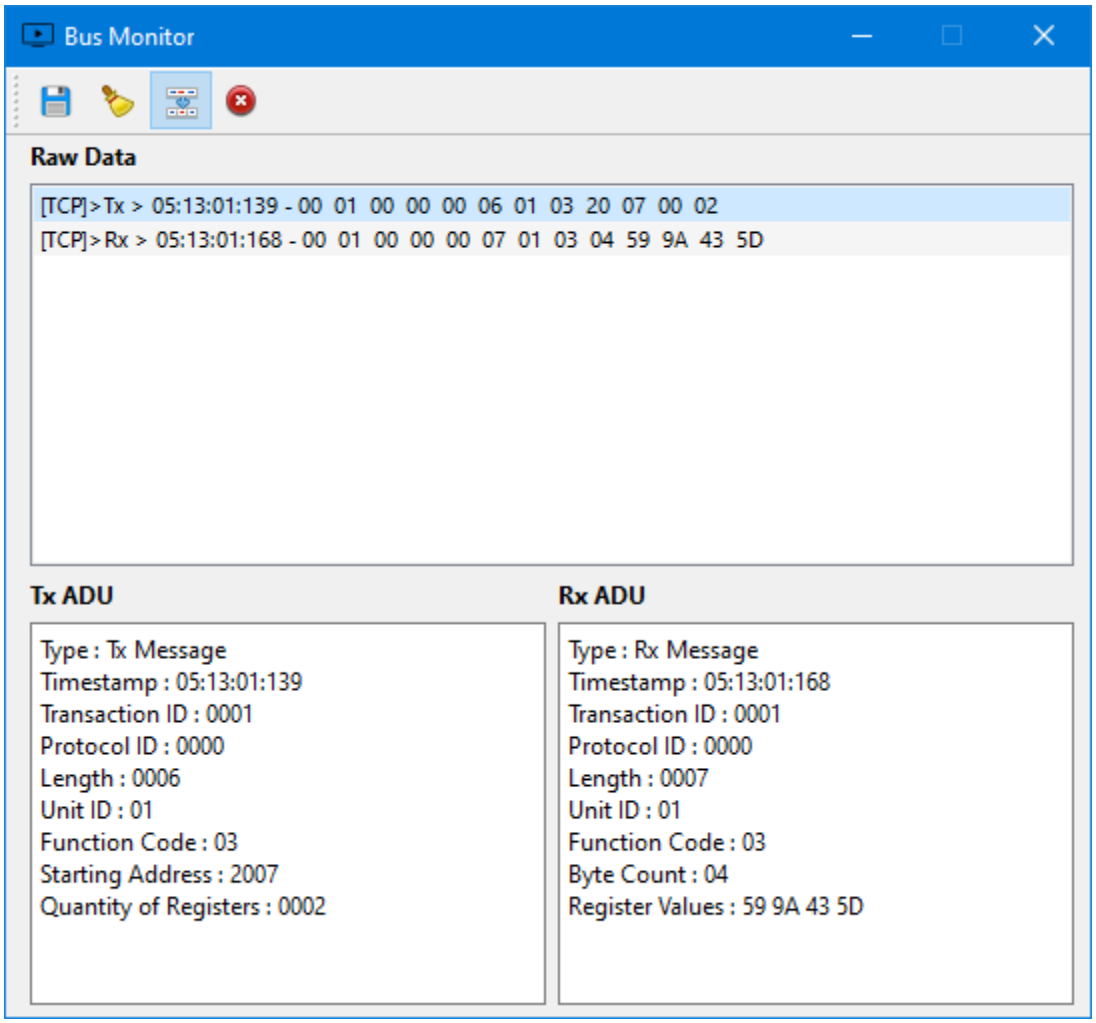
- Click on the **Connect** icon to establish a TCP/IP connection to the LWIFI equipped instrument.
- Click on the **Bus Monitor** icon to view the command/response operation.
- And finally, click on the **Read/Write** icon to perform the operation.



The instrument's displayed value of 221.35 is read and presented in the main QMod-Master window. The values in holding registers 8200 and 8201 are combined to form a 32-bit value and are displayed in floating point format.



The QModMaster Bus Monitor window below presents the Modbus Command transmitted to the LWIFI and its response. Note that the hexadecimal values of **59 9A 43 5D** represent the value in IEEE 754 floating point format (little endian). See Wikipedia for a condensed description of IEEE 754.



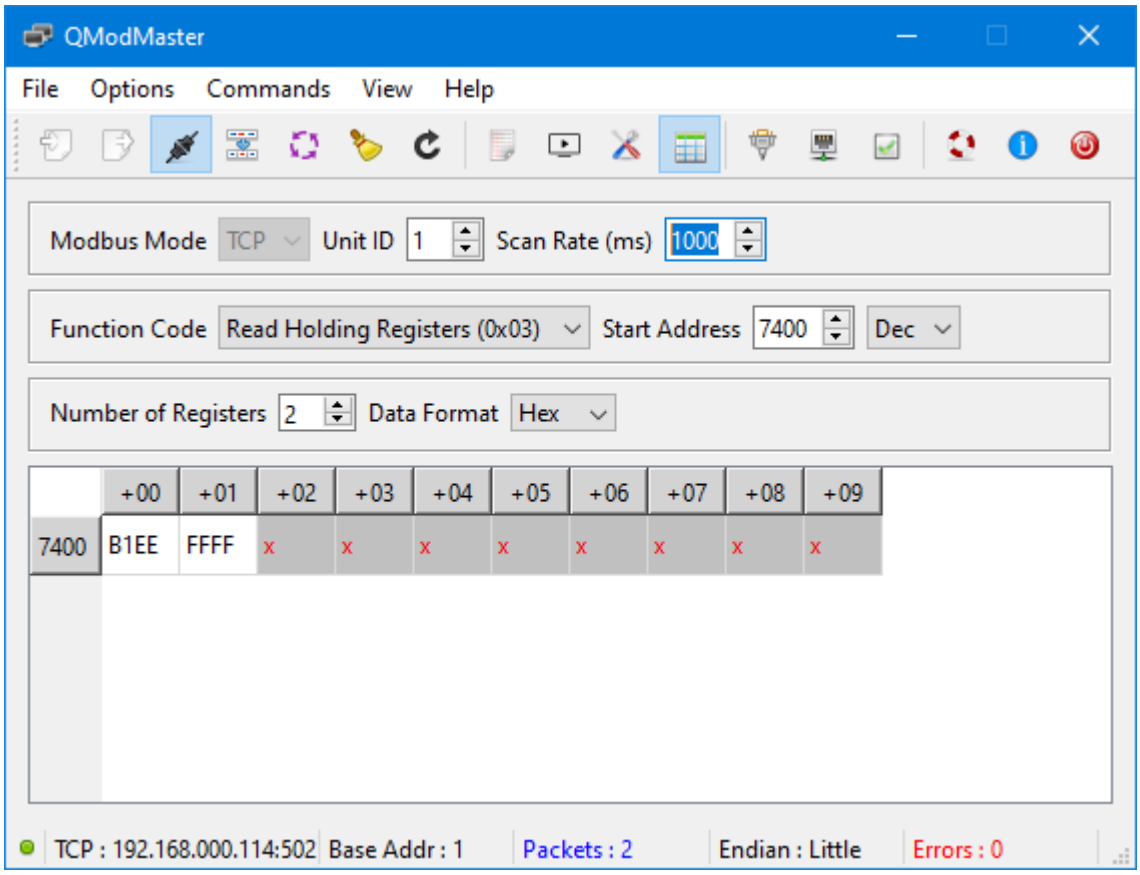
5. Example 2: Obtaining a Signed Integer Measurement from a DC Voltmeter

This example uses a Modbus command to read the currently displayed signed integer value from an LWIFI equipped DC voltmeter. The TCP configuration of QModMaster is the same as for the previous example. In this case, the instrument is displaying -199.86. The screen capture below shows the main window of QModMaster which is setup to read the displayed integer value.

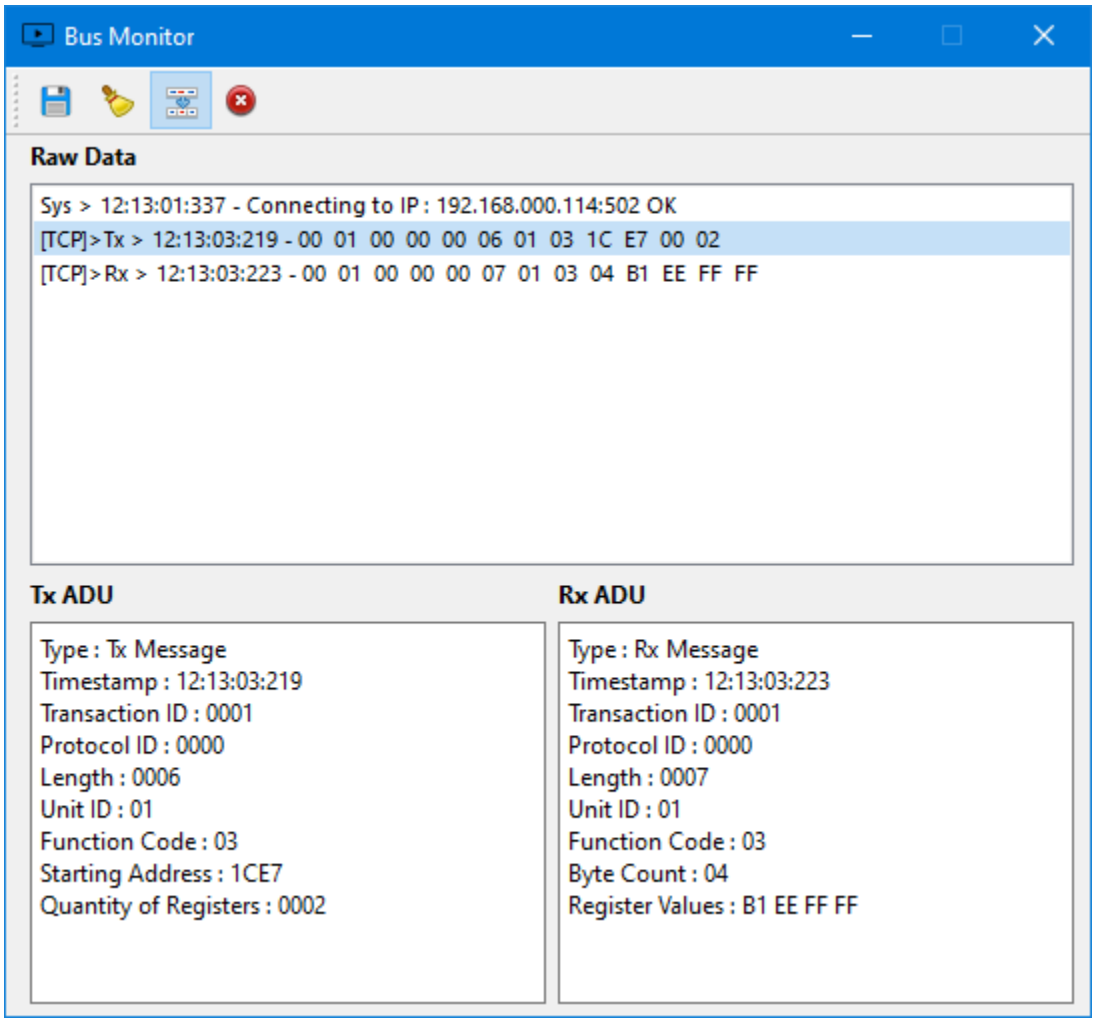
The critical items are:

- Modbus Mode = **TCP**
- Function Code = **Read Holding Registers (0x03)**
- Start Address = **7400** (Dec)
- Number of Registers = **2**
- Data Format = **Hex**

The **Read/Write** icon has been clicked and the values of holding registers 7400 and 7401 are displayed.



The QModMaster Bus Monitor window below presents the Modbus Command transmitted to the LWIFI and its response. Note that the hexadecimal byte values of **B1 EE FF FF** represent the 32-bit signed two's complement display value. The four bytes are combined as **FFFFB1EE** to form the 32-bit value which is -19986 decimal. A condensed description of two's complement is available on Wikipedia.


Bus Monitor
Raw Data
Sys > 12:13:01:337 - Connecting to IP : 192.168.000.114:502 OK
[TCP]>Tx > 12:13:03:219 - 00 01 00 00 00 06 01 03 1C E7 00 02
[TCP]>Rx > 12:13:03:223 - 00 01 00 00 00 07 01 03 04 B1 EE FF FF
Tx ADU
Type : Tx Message
Timestamp : 12:13:03:219
Transaction ID : 0001
Protocol ID : 0000
Length : 0006
Unit ID : 01
Function Code : 03
Starting Address : 1CE7
Quantity of Registers : 0002
Rx ADU
Type : Rx Message
Timestamp : 12:13:03:223
Transaction ID : 0001
Protocol ID : 0000
Length : 0007
Unit ID : 01
Function Code : 03
Byte Count : 04
Register Values : B1 EE FF FF

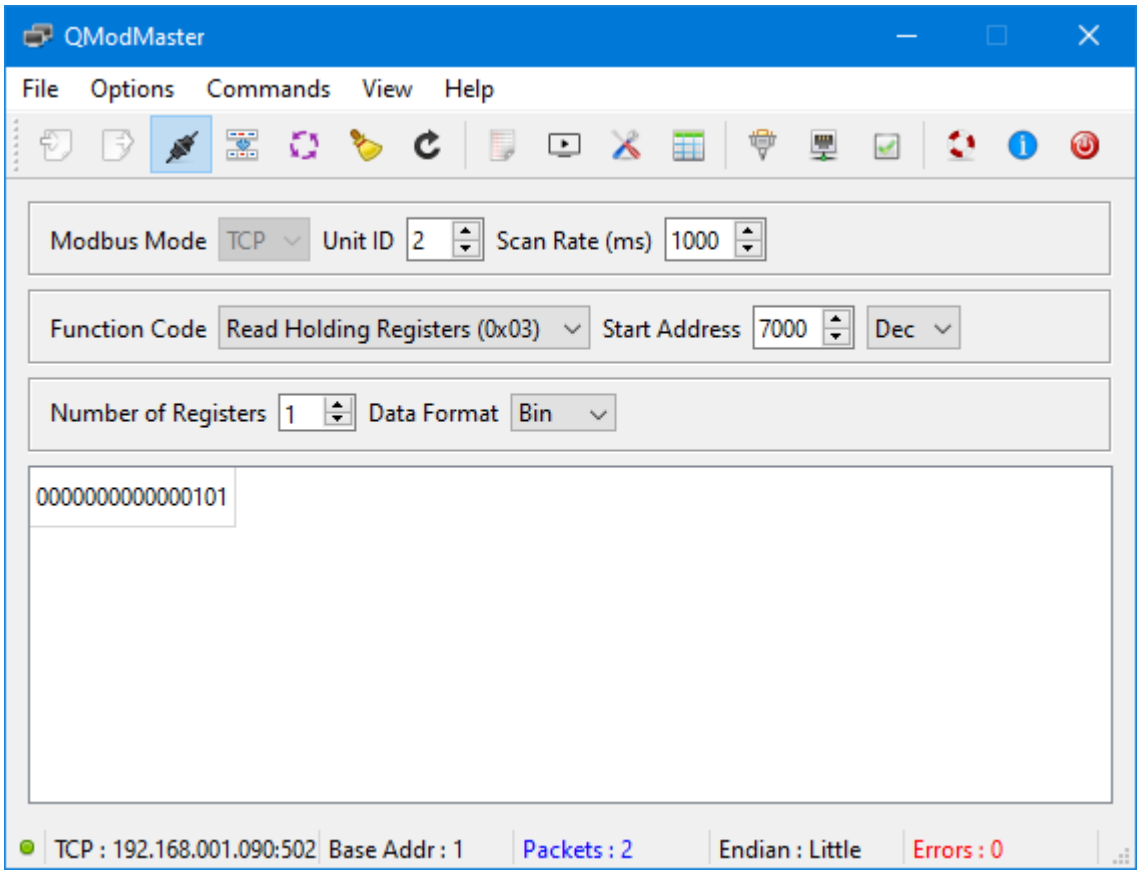
6. Example 3: Reading Alarm & Overload Status from a DC Voltmeter

This example uses a Modbus command to read the alarm and overload status from an LWIFI equipped DC voltmeter. The TCP configuration of QModMaster is the same as for the previous example.

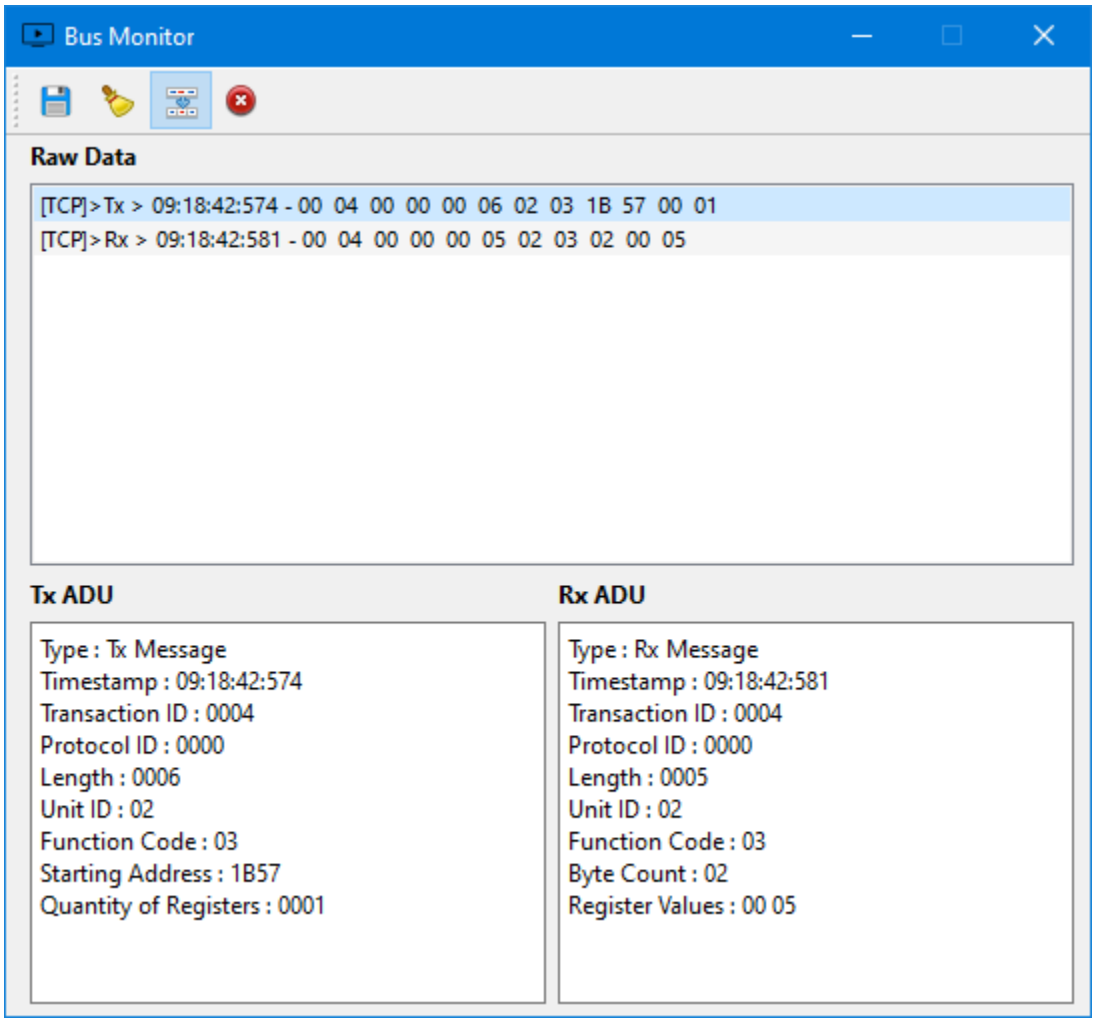
The screen capture below shows the main window of QModMaster which is setup to read the alarm and overload status. The critical items are:

- Modbus Mode = **TCP**
- Function Code = **Read Holding Registers (0x03)**
- Start Address = **7000** (Dec)
- Number of Registers = **1**
- Data Format = **Binary**

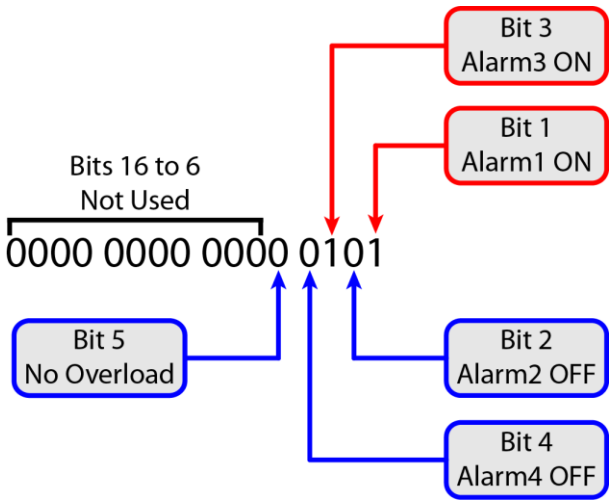
The **Read/Write** icon has been clicked and the 16-bit value of holding register 7000 is displayed.



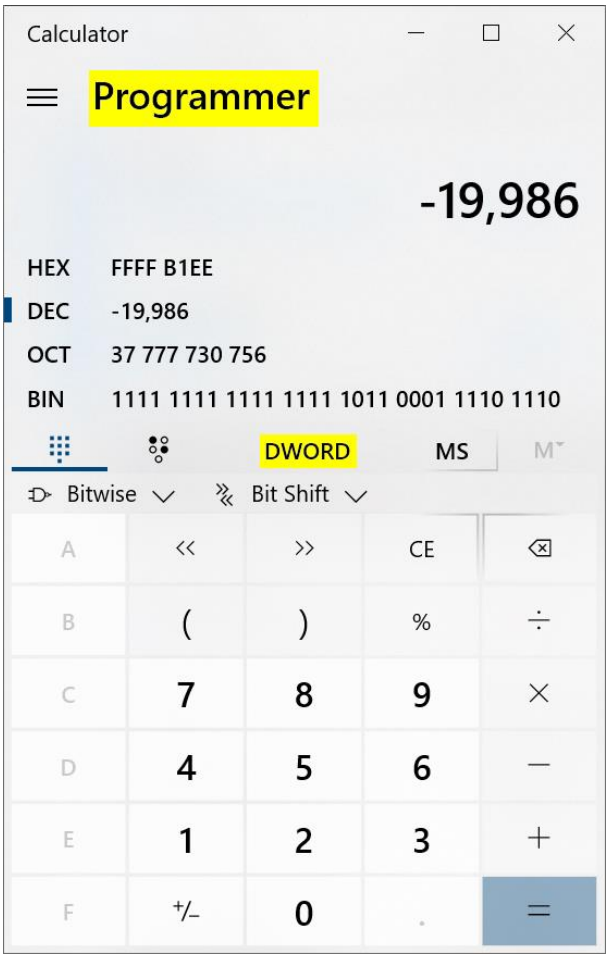
The QModMaster Bus Monitor window presents the Modbus Command transmitted to the LWIFI and its response. Note that the hexadecimal byte values of **00 05** represent the same alarm and overload status shown above in binary.



The diagram below describes how each of the bits is interpreted:



You may wish to use the Windows calculator to convert two's complement values to decimal and vice versa.



12. GEN 2 COMMUNICATION BOARD SPECIFICATIONS

Communication Interfaces, LWIFI Board

Communication ports	WiFi with integral antenna, USB 2.0 port, RS485 port
WiFi module	ATWINC1510-MR210PB (with integral antenna)
Antenna	2.4 GHz printed antenna
USB interface	USB 2.0 via mini-USB connector

Communication Interfaces, LWIFIX Board

Communication ports	WiFi with external antenna, USB 2.0 port, RS485 port
WiFi module	ATWINC1510-MR210UB (for external antenna)
Connector to external antenna	Hirose male U.FL
Antenna cable type	50 ohm RG174
Cable length	760 mm (30”)
Cable loss at 2.4 GHz	2 dB
Cable connectors	Female U.FL to circuit board, RP-SMA to antenna
Antenna	External omnidirectional 2.4 GHz dipole
Antenna polarization	Vertical
Antenna gain	5 dBi
Antenna height	200 mm (8”)
Recommended antenna location	Top horizontal surface of metal cabinet
USB connector	Mini-USB Type B
RS485 connector	RJ11

Communication Interfaces, LNET1 Board

Communication ports	Ethernet port, USB 2.0 port, RS485 port
Ethernet connector	RJ45
USB connector	Mini-USB Type B
RS485 connector	RJ11

WiFi Performance

Wireless LAN standard	IEEE 802.11 b/g/n
Transmit/receive frequency	2.4 GHz license-free ISM band
Maximum data rate with 802.11 n	72.2 Mbits/sec, MCS index 7
Maximum radio range, unobstructed outdoors	90 m (300 ft)

USB Performance

USB applications	Meter programming or data transfer
USB connector	Mini-USB
USB cable	Mini-USB to USB Type A connectors (CBL07)
USB data rate	38400 baud for Modbus, 19200 for Instrument Setup software
COM port	Discovered by Laurel Network Setup (NS) utility

RS485 Performance

RS485 applications ..... WiFi or Ethernet to RS485 gateway or polling by PC
RS485 connector..... 6-pin RJ11
RS485 cable..... Non-reversing 6-wire data cable with RJ11 connectors (CBL03)
RS485 data rate ..... 19200 for Instrument Setup software or RS485 gateway,
1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200 baud for polling by PC
COM port..... Discovered by Laurel Network Setup (NS) utility

Cache Operation

Data written into cache.....Display value or set of 6 values
6 values for analog input DPM .....
.....Alarm status, display value, peak, valley, display value, display value
6 values for scale/ weight meter.....
..... Alarm status, display value, peak, net weight, gross weight, display value
6 values for pulse input counter/timer .....
.....Alarm status, item 1 (display value), peak, valley, item 2, item 3

Write interval into cache for 1 value .....16.666 msec or 20.000 msec
Write interval into cache for 6 values .....100 msec or 120 msec
Read interval from cache ..... Set by external Modus Master, 10 msec minimum

Measurement Update Intervals

Analog input meter ..... 16.666 or 20.000 msec (set for 60 or 50 Hz noise rejection)
Frequency/rate pulse readings..... Gate time + 30 msec + 1-2 signal periods

Communication Protocols

Meter polling via Ethernet or WiFi ..... Modbus TCP/IP (same command set as RTU)
Meter polling via USB or RS485..... Modbus RTU
System internal.....Custom ASCII protocol

Mechanical

Gen 2 board dimensions .....79 x 39 mm
Mounting location ..... Middle slot of Laureate Series 2 panel meter or counter

Environmental

Operating temperature ..... -40°C to 85°C
Relative humidity ..... 95% from 0°C to 85°C, non-condensing

13. WARRANTY

Laurel Electronics Inc. warrants its products against defects in materials or workmanship for a period of one year from the date of purchase.

In the event of a defect during the warranty period, the defective unit may be returned to the seller, which may be Laurel or a Laurel distributor. The seller may then repair or replace the defective unit at its option. In the event of such a return, freight charges from the buyer shall be paid by the buyer, and freight charges from the seller shall be paid by the seller.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from:

1. Improper installation or miswiring.
2. Improper or inadequate maintenance.
3. Unauthorized modification or misuse.
4. Operation outside the environmental specifications.
5. Mishandling or abuse.

The warranty set forth above is exclusive and no other warranty, whether written or oral, is expressed or implied. Laurel specifically disclaims implied warranties of merchantability and fitness for a particular purpose.

Any electronic product may fail or malfunction over time. To minimize risks associated with reliance on Laurel products, users are expected to provide adequate system-level design and operating safeguards. Laurel's products are intended for general purpose industrial or laboratory use. They are not intended nor certified for use in life-critical medical, nuclear, or aerospace applications, or for use in hazardous locations.

Exclusive Remedies

The remedies provided herein are Buyer's sole and exclusive remedies. In no event shall Laurel be liable for direct, indirect, incidental or consequential damages (including loss of profits) whether based on contract, tort, or any other legal theory.